Title	**Proximity effect of shopping center**
Other Contributor(s)	**University of Hong Kong**
Author(s)	**Lam, Chun-cheong; 林振昌**
Citation	
Issued Date	**2007**
URL	**http://hdl.handle.net/10722/131055**
Rights	**The author retains all proprietary rights, such as patent rights and the right to use in future works.**

THE UNIVERSITY OF HONG KONG

PROXIMITY EFFECT OF SHOPPING CENTER - AN EMPIRICAL STUDY OF THE IMPACT OF HIGH ORDER MALL ON THE RENT OF QUASI-PUBLIC SHOPPING CENTER IN HONG KONG

A DISSERTATION SUBMITTED TO THE FACULTY OF ARCHITECTURE IN CANDIDACY FOR THE DEGREE OF BACHELOR OF SCIENCE IN SURVEYING

DEPARTMENT OF REAL ESTATE AND CONSTRUCTION

BY

LAM CHUN CHEONG (2004225426)

HONG KONG

APRIL 2007

Declaration

I declare that this dissertation represents my own work, except where due acknowledge is made, and that it has not been previously included in a thesis, dissertation or report submitted to this University or to any other institution for a degree, diploma or other qualification.

Signed: _____

Name: _____

Date: _____

Acknowledgements

I would like to express my greatest gratitude to my supervisor, Dr Edward C.Y. Yiu for his continuous guidance, patience and support throughout the whole process of this dissertation. Without his kind support and inspiration, I would not have been able to complete this dissertation.

Special thanks are given to Mr Matthew Leung, PhD student of the University of Hong Kong, for his enlightening advice and generous help throughout the process of this dissertation. I would also like to express my sincere thankfulness to Mr Walter Yu, my mentor, for his encouragement and precious opinions on this dissertation topic.

Finally, I would like to thank my parents, friends and studio group-mates for their continuous support and encouragement.

Abstract

It has often been said that the three most important properties of a retail store are location, location, and location (Jones and Simmons 1990). Location is an important factor governing the success of a shopping center. In a highly urbanized city, like Hong Kong, land is scarce and population is dense. Following the development of more high order mall in recent years, it is common to find shopping center located near to high order mall. The interaction between them is worth to study, as it definitely affects the site selection decision of a shopping center. However, little research focuses on the proximity impact of shopping centers' location on their rents. Hence, this study expands the limited research by investigating the proximity effect of high order mall on the rental rate of shopping center in Hong Kong. The study hypothesizes that while proximity to high order mall may incur competition, the presence of nearby high order mall may be beneficial. With the availability of data from the Global Offering of the Link, a real estate investment trust in Hong Kong, the proximity effect of high order mall on the rent of quasi-public shopping center is empirically studied. Applying regression analysis, an empirical model relating shopping center rent and direct distance to the nearest high order mall is generated. The results reveal that shopping center in closer proximity to high order mall can generate higher rent from the tenants. In order to further confirm the hypothesis, variable measuring the number of high order mall in primary trade area is added to the base model in place of the nearest distance to high order mall variable. It measures the effect of proximity to high order mall due to the presence of high order mall in the primary trade area. Shopping center rent is found to be higher when there are more high order malls existed in the primary trade area. The results of this study give insight to planners or developers about the proximity impact of high order mall on the shopping center rent. It is hoped that the findings can contribute in helping them to make an appropriate location

decision in the development of shopping center.

Table of Contents

List of Illustrations

Figures

Tables

Chapter 1: Introduction

1.1 Background

Shopping is perhaps one of the most important leisure activities in nowadays society. Along with the economic development and the change in consumer culture, shopping centers in Hong Kong have gradually replaced the traditional street frontage retailing and become the major venues for shoppers. Though traditional street frontage retailing has remained important in the older shopping areas, its significance has declined in new development areas due to the growth of air conditioned and self-contained shopping center. (Hong Kong Planning Standards and Guidelines, 1998)

Hong Kong is well-known in the world as a shopping paradise. There are many retail stores, shopping centers in the region, providing a wide range of products and services to customers from day to night. The retail industry plays an important role in the local economy, and this can be shown by the following statistics. In 2006, the retail market in Hong Kong experienced a strong growth, with an annual growth rate of 7.3 percent, and generated a total retail sale of HK$ 219,565 million. (Figure 1) The retail sales in turn contributed to approximately 14.9 percent of total Gross Domestic Product[1]. Completions of private commercial premises in 2006 were 183,000 m^2, with an increase of 65 percent over the previous year. (Figure 2) The completions were mainly located in Kowloon. For example, Yau Tsim Mong and Kwun Tong contributed 62% of the total supply.

[1] Website of the Census and Statistics Department [online]
Available from: http://www.censtatd.gov.hk/hong_kong_statistics [Accessed 7-1-2007]

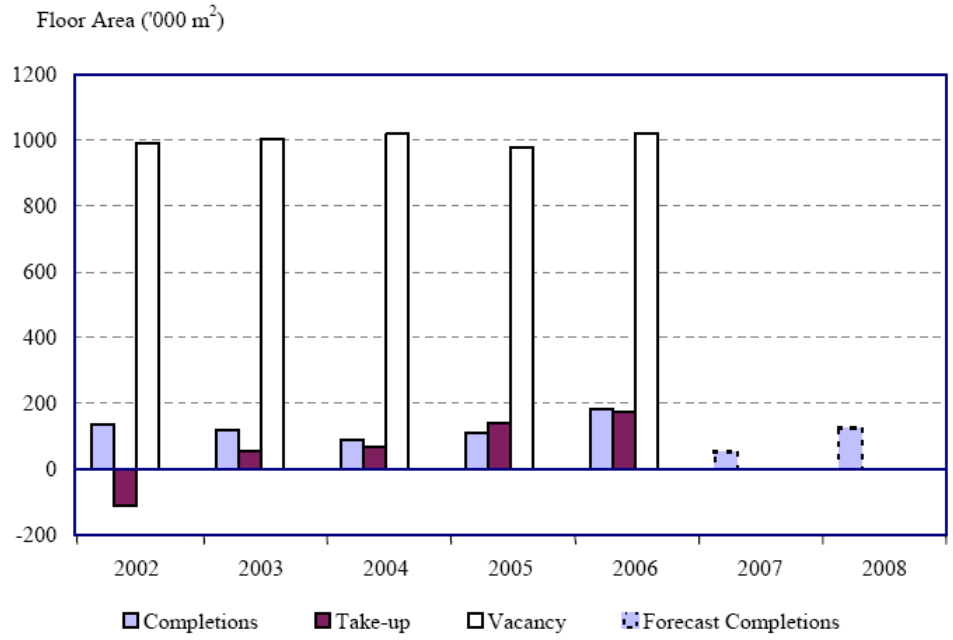
Table 1.1: Summary of Total Retail Sales in 2006

Year	Month	HK$ (Million)	Index (Monthly average of 10/2004 - 9/2005 = 100)	Year-on-year % change
2006	Jan	21,162	125.7	+11.6
	Feb	16,168	96.0	-3.2
	Mar	17,950	106.6	+9.0
	Apr	18,603	110.5	+9.5
	May	18,586	110.4	+5.3
	Jun	17,411	103.4	+5.2
	Jul	18,652	110.8	+7.1
	Aug	17,898	106.3	+8.4
	Sep	16,886	100.3	+7.6
	Oct	17,781	105.6	+7.0
	Nov	16,973	100.8	+7.4
	Dec	21,495	127.7	+11.6
	Total	**219,565**	**108.7**	**+7.3**

Notes: The value index measure the changes in value terms

Source: Census and Statistics Department (2006)

Figure 1: Completion of Retail Premises 2002-2008



Notes: a) Completions refer to premises issued with an occupation permit

b) Take-up represents the net increase in the number of units occupied in the year under

review.

Source: Hong Kong Property Review (2007) Preliminary Findings

Regardless of the increasing importance of the retail industry to the local economy, there is relatively little research to analyze the rental rate of retail facilities in Hong Kong. Empirical studies on the local property market have mainly focused on the residential property or office sector. While most of the previous empirical research on retail rent is conducted in United States and Europe, the research on local retail market is relatively scarce.

To date, there has been little empirical research into the determinants of retail rent. There are some inherent difficulties in empirical study of retail rent that make it a less prevailing topic among researchers. Shopping centers are generally considered the most complex to manage and operate among all real properties. It is because there are considerable numbers of factors governing the success of a shopping center, like location, accessibility, visibility, management and marketing, the right tenant mix. (Alexander and Muhlebach 1992) Thus, it is not easy to identify all the related variables in an empirical model. Furthermore, the researches are often hampered by a lack of adequate data, especially for those done in Hong Kong, in which the rental information of retail facilities is considered as confidential. The data set of retail facilities obtained is relatively small comparing with other properties, like residential etc. Owing to these, the explanatory power of the empirical model in empirical retail research is often low.

Though it is universally accepted that the choice of location is an important factor governing the success of a shopping center, there has been a lack of comprehensive research on its proximity impact on the rental rate of a center. Hence, in attempt to further advance the limited literature in local retail market, especially the impact of shopping

centers' location on their rent, this study aims at providing an empirical study of the proximity effect of high order mall on shopping center rent in Hong Kong. More importantly, comprehensive explanations are provided for the abovementioned proximity effect. It is hoped that the results of this study can give useful insights to planners and developers of the shopping center about the impact of proximity to competition on the rental rate of a shopping center.

1.2 Objectives

To sum up, this study has basically three objectives:

1) To identify the major factors which determine the rental rate of a shopping center,
2) To investigate empirically the proximity impact of high order mall nearby on the rent of quasi-public shopping center, and
3) To interpret and explain the results of the empirical study on the above issue

1.3 Scope of the study

Rental information of retail facilities of different types was released through the global offering of the Link, a real estate investment trust (REIT) in Hong Kong in 2005. The assets of the Link are mainly retail and carpark facilities previously owned by the Hong Kong Housing Authority. With the availability of rental information, the scope and focus of this study are confined to the quasi-public shopping centers held by the Link.

1.4 Importance of the study

In a highly urbanized city, like Hong Kong, land is scarce and population is dense. The retail structure of Hong Kong is characterized by the heavy concentration of retail activity, especially in the urban area. Hence, shopping centers in Hong Kong face a high level of

competition, as they are usually placed near to each other and having similar catchment area. Following the development of more high order shopping malls in Hong Kong, it results in a keener competition in the retail market. Owing to this, the proximity impact of high order mall on the shopping center rent is worth to study, as the study can give insight to planners or developers of shopping centers in making location decisions so as to substantiate their survival in the highly competitive retail market.

1.5 Methodological framework

The methodology used in the study contains mainly three parts.

A literature review will be carried out to provide an overview of the classical shopping center literatures. Previous empirical studies on the determinants of retail rent will also be reviewed in order to identify some primary determinants of shopping center rent. This will help to form the base of the empirical study, and the determinants identified can be used as control in the investigation. In addition to these, similar retail studies will be reviewed to ascertain the proximity effect of high order mall on the shopping center rent.

Multiple regression will be carried out to empirically test the proximity effect of high order mall on the shopping center rents, with the average shopping center rent as the dependent variable, distance to the nearest high order mall or number of high order mall in the primary trade area[2], and some primary determinants of shopping center rent as the independent variables. The reasons and criteria for choosing the included determinants will be explained and clarified.

[2] The shopping center's primary trade area is the geographic area from which the shopping center derives 60-65 percent of its customers. In this study, it is defined as a one-kilometer radius encircling the shopping center site. The definition of one-mile radius trade area is used in previous studies (e.g. Gatzalaff, Sirmans and Diskin, 1994). However, the author believes that a trade area of 1 km radius is reasonable enough for the retail study conducted in Hong Kong.

Finally, the regression results of the finalized models will be analyzed and explained, whether or not the result is as expected or not.

1.6 Organization of the study

The dissertation is composed of six chapters.

Chapter 1 is Introduction. This chapter introduces the background, objectives, scope of study, methodological framework and organization of the dissertation.

Chapter 2 is Literature review. It provides an overview of the classical shopping center literatures. Previous empirical studies on the determinants of retail rent and similar retail studies will be reviewed as well.

Chapter 3 provides the classification of shopping centers and definitions of important terms used in the study. Some main features of retail industry in Hong Kong will also be reported.

Chapter 4 presents a deduction of hypothesis in the study, the methodology used, selection of variables and sources of data. A general overview of the Link, a real estate investment trust in Hong Kong will be given as well.

Chapter 5 reports the empirical model and result. It introduces the empirical models used in the study. The results of empirical models will then be analyzed and discussed in this chapter

Chapter 6 is a conclusion. It summarizes the results and implications of the dissertation. Limitations of the study and further research areas will be provided.

Chapter 2: Literature Review

The main focus of this dissertation is to investigate the proximity effect of nearby high order shopping mall to the rent of shopping center. The related study about retail agglomeration will be discussed in this chapter. The discussion will be separated into three parts. Firstly, different retail theories will be introduced briefly. Secondly, literatures concerning empirical investigations of retail rent will be discussed. Lastly, previous similar studies will be examined and critically reviewed.

2.1 Retail theory

Shopping center research has been developed for many years. As Eppli and Benjamin (1994) mention in their paper, the shopping center research has broadly followed two separate, but also inter-related theories, namely the Central Place Theory and Homogeneous retailer agglomeration. In addition, shopping center demand externality is also a more recent area of shopping center research. In the following, the main thesis and development of these three theoretical streams will be discussed respectively.

2.1.1 Central Place Theory

Central Place Theory (Christaller 1933; and Losch 1938) models the relationship of trade between towns. In retail research, it focuses on the issue of where a retailer should site a facility or where a developer should build a shopping center. To organize the complexity of inputs in spatial decision making, Central Place Theory comprises of two variables, namely range and threshold. In brief, range is the maximum distance a consumer will travel to purchase a good, which for Christaller is equal to the distance to the nearest center that carries the good. Threshold refers to the minimum demand required to economically support the facility. It is a useful way to determine the number and location

of retail centers using the minimum return necessary for the retailer to break even. Thus, range and threshold combine to form a market area, which is hexagonal in shape. Losch (1938) suggests the hexagonal market area in his classical paper "Nature of Economic Regions", because hexagonal is the most economical shape for trading areas. The adjacent hexagons are packed continuously to form the entirety of the market areas. The key postulate of Central Place Theory is that consumers will make single purpose shopping trips to the nearest shopping center.

Central Place Theory remains a foundation for retail modeling, but has been elaborated and expanded to extend their initial assumptions. The theory is based on the simplifying assumptions that shoppers make single trips and seek to minimize the price paid for merchandise in both travel cost and the cost of the goods purchased. The most restrictive assumption is that the consumers visit the nearest center while taking a single purpose trip. The subsequent research related to Central Place Theory mostly investigates the single purpose shopping trip hypothesis in the theory. Berry (1967) provides an early test of the hypothesis by empirically testing the single purpose shopping trip. Through investigating the consumer purchasing behavior in rural Iowa, most of his initial findings generally support the theory. Nevertheless, the findings do not stop the criticism and elaboration of the following scholars. The empirical studies of Golledge, Rushton and Clark (1966) and Rushton, Golledge and Clark (1967) reveal that consumers do travel further than the nearest shopping center to purchase goods or services. These two studies are important as they challenge the previous findings of Berry and give the first demonstration of the potential for multipurpose shopping in the real world. However, their studies do not give strong empirical support for the existence of multi-purpose shopping trip. Hanson (1980), using the data collected in Upsala, Sweden, rejects the nearest center assumption due to the observed complexities in consumer travel behavior. The findings of Hanson (1980)

reveal the necessity of including the consumer's trend of multi-purpose shopping into the Central Place Theory. The subsequent empirical research of O'Kelly (1981) generally supports Hanson (1980)'s findings. These two researches are significant in the retail theory as they reveal definite observations of multi-purpose shopping behavior.

Though there are many studies criticizing the generality of Central Place Theory, none of the studies can refute the explanatory power of the theory regarding spatial configuration. Central Place Theory earns its strength through its general structure and its ability to analyze complex locational problems under highly simplifying assumptions. Nevertheless, while the theory continues to generate ideas for retail demand analysis, the theory is still bound by its simplifying assumptions. As in the real world, single purpose shopping trips can not represent the shopping trips of all consumers. The fact is that most consumers choose to go for multi-purpose shopping.

2.1.2 Homogeneous retail agglomeration

In his classical paper "Stability in Competition", Hotelling (1929) gives rise to the conceptual ideas and the theoretical base of the principle of minimum differentiation, which explain why the shops of similar kinds agglomerate. In his model, it reveals that when two competing firms sell a homogeneous product, they will agglomerate in the center of a market. He tries to prove that price stability can be maintained in the case of two-firm competition when homogeneous products are slightly different. In other words, Hotelling thinks that a slight reduction of price by a retailer will not cause a loss of many customers, because many consumers will purchase in a shop regarding to the quality of goods, or their mode of doing business, rather than looking at the price alone.

A considerable amount of retail research has been done since Hotelling's pioneering

contribution. The research can be briefly classified into three categories.

One of the most arguable views on Hotelling's work is the existence of homogenous retail agglomeration equilibrium. Hotelling is contended that two competing firms selling a homogeneous product will agglomerate in the center of the market, and price stability can be maintained. This pioneering thought is in contrast to the prevalent theories before the publication of Hotelling's model, which believe that consumers only conduct business with a retailer by looking solely at the price. Only the lowest price retailer can survive and hence price stability can not exist. Subsequent research demonstrates a number of conditions in which the clustered equilibrium does not exist. For example, Chamberlin (1933) tests the existence of agglomeration equilibrium with three retailers in the center of the market. It then causes an unstable leap-frogging process, as each competitor attempts to capture the prime exterior sites. Therefore, when more than three firms, up to 256 firms tested, he proposes that retail agglomeration will arrive at a disperse equilibrium, rather than a stable clustered equilibrium. The existence of agglomeration equilibrium is also proved to be invalid by Lerner and Singer (1937) in the case of three firms. Chamberlin (1933), as well as Lerner and Singer (1937) provide the earliest study challenging the existence of clustered equilibrium. However, their studies assume that both products and consumer tastes are homogeneous. When these assumptions are relaxed, this gives rise to subsequent study of De Palma, Ginsburgh, Papageorgious and Thissse (1985) (hereafter De Palma et.al.) which support the existence of stable clustered equilibrium when relative degree of heterogeneity is integrated in both product and consumer taste. Apart from the number of retailers in the clustered equilibrium is concerned, the result of Eaton and Lipsey (1975) also reveals that there is no stable equilibrium under either a one-dimensional or a two dimensional market space. If there is an increase in number of firms serving Hotelling's one dimensional market, firms will

never be grouped in clusters larger than two firms. Hence, clustering is a necessary condition of equilibrium only at the peripheries of the market. Subsequently, Eaton and Lipsey (1982) demonstrate that when demand is responsive to delivered price, firms in the interior of a one-dimensional market will be equally spaced. Hence, even Hotelling's model is so amended, a clustering of even two firms cannot occur. Following Eaton and Lipsey's findings, subsequent researches by d'Aspremont, Gabszewicz and Thisse (1979), Gabszewicz and Thisse (1986) and Economides (1984) also deny the existence of a stable clustered equilibrium, assuming a homogeneous products and consumers.

Despite of the numerous results showing the non-existence of stable clustered equilibrium, there is some research showing that a stable clustered equilibrium does exist. Webber (1972) shows that a stable agglomerated central market does exist when uncertainty and risk reducing behavior are incorporated into the Hotelling problem and realistically assuming a once-and-for-all locational choice. This conclusion also holds when the initial assumptions of zero conjectural variation, duopolistic competiton, inelastic demand and homogeneous market etc. are relaxed. In another study, De Palma et.al. (1985) reformulate the Hotelling model and show that the Principle of Minimize Differentiation is restored when products and consumers are sufficiently heterogeneous.

There is also a considerable amount of research investigating the relationship between comparison shopping and the homogeneous agglomeration of retailers. It is clear that there is a discrepancy in Hotelling's theory to explain homogeneous retail agglomeration, due to its highly restrictive and unrealistic assumptions. Thus, comparison shopping is more recently used to explain the observation of homogeneous retail agglomeration. The comparison shopping literature often refers to consumer uncertainty in retail models. The underlying principle is that when consumers are uncertain of whether they will find their

desired products in a particular retailer, they will try to reduce this uncertainty by patronizing at the agglomerated retail site. This can serve to reduce the uncertainty of finding a desired product, as comparison shopping is made possible. Eaton and Lipsey (1979) have shown in their paper that comparison shopping provides a theoretically valid explanation of the clustering of firms. They have also shown that the clustering of firm can be socially useful as it acknowledges the consumer's desire to make comparisons among retailers selling the same goods. In another research by Bucklin (1967), he categorizes comparison shopping behavior into three separate categories, namely full search, directed search and causal search, based on the type of good purchased by the consumers. The result reveals that for full search goods, the transportation involved in making multi stops at different located centers often outweighs the expected price savings of the shopping experience. Thus, he concludes that, for full search goods, the literature of marketing probably over-emphasizes the desire to save money as a basis for shopping.

2.1.3 Demand externalities

Demand externalities are the positive effects generated from one tenant, usually the high-order anchor tenant retailer, to the low-order smaller retailer. Customers are drawn to the shopping center by an external force, usually the high-order anchor tenant retailer. Ingene and Ghosh (1990) propose that retail center specific attributes can affect retail performance, and this proposition then forms the basis for demand externality theory. The theory acknowledges that center specific attributes, such as the image of the anchor tenant, tenant mix and center design can affect the center performance. The customer draw of anchor tenants is primarily dependent on the image of the retailer. Favorable retail image can draw customer from greater distance. Stanley and Sewall (1976) conduct a study to measure the effect of image of supermarket, making use of the data collected by personal interviews. The result reveals that stores with more favorable image can draw customers

from longer distance. However, the result is not statistically conclusive as it only draws from a number of personal interviews with the women on supermarket preferences. Consequently, the generality of the result is in doubt. Nevin and Houston (1980) also conduct an empirical analysis concerning the effect of shopping center image and tenant mix. The result shows that anchor department store is an important shopping center draw, while tenant mix is also an important center attribute contributing to the performance of the center. Compare with the similar research by Stanley and Sewall (1976), this study gives a more statistically conclusive result. It is because it collects data by the response from questionnaires sent to 2000 homes, in which a greater variety of opinions can be obtained. The subsequent research done by Anderson (1985) has also shown the similar result. Eppli (1991) further extends the research by empirically testing the effect of size and image of anchor tenants on the non-anchor tenants in regional shopping centers. The result reveals that the image of anchor store provides a positive impact to the non anchor tenant sales. Eppli and Shilling (1993) also reveal in their paper that the quantity of space devoted to anchor tenant in the center shows a positive effect on the non anchor tenant sales. Brueckner (1993) mentions in his paper that there are both anchor tenant and non-anchor tenant externalities, i.e. inter-store externalities in the center. Thus the shopping center owner or manager will try to lease the space in the center to various kinds of tenant so as to maximize the profit. Subsequently, Miceli, Sirmans and Stake (1998) show in their paper that profit maximizing developer may allow within center competition, as the presence of shopping externalities and increased customer traffic can increase the center's overall profit. In a more recent study by Hardin and Wolverton (2001), the impact of neighborhood center image on rental rates is empirically modeled and studied. The result reveals that the image related facilities specific variables of the center, like the age of the center etc, are important determinants of the neighborhood center rent. However, it is also shown in the paper that anchor store image does not affect much on the non-anchor

tenant rent in neighborhood center. This finding is in contrast with the previous research concerning anchor tenant image.

2.2 Retail rent

Although there have been many studies of retail activity, only limited empirical research into the determinants of retail rent is done. The empirical investigations of retail rent are interfered by the lack of adequate data. Benjamin, Boyle and Sirmans (1990) provide the first empirical analysis of variations in rents across the leases. The result reveals that the base rent for lease is affected by tenant profile, and there is an interaction between lease term and percentage rents. Sirmans and Guidry (1993) investigate the determinants of all types of shopping centers. The results show that rent level of the center is affected by size, age and tenancy. Gatzlaff, Sirmans and Diskin (1994) and Sirmans, Gatzalaff and Diskin (1996) show that the vacancy and rental rate of shopping center are affected by the loss of anchor tenant. The paper by Ownby, Davis and Sundel (1994) (hereafter Ownby et al.) is somewhat different from the other similar studies as far as the methodology used is concerned. They study the opinions of practitioners on the determinants of neighborhood center rent. The result reveals some influence of location variables, like the number of competing neighborhood center nearby etc, based on the opinions of practitioners. Gerbich (1998) empirically tests the significance of types of tenant on the base rents of the shopping centers. The result shows that type of tenants is a key determinant of the base rents of the center. Hardin and Wolverton (2000) investigate the determinants of neighborhood center rental rates, using a more extensive set of detailed data in America. Property specific characteristics, including the center size, the center age etc, as well as the primary trade area economic capacity of the center, are confirmed again to be the primary determinants of center vacancy rate and rental rates. In a subsequent study by Hardin and Wolverton (2001), the impact of neighborhood center image on the rental rent

is empirically modeled and tested. Hardin, Wolverton and Carr (2002) empirically investigate the determinants of community center rent by employing a two-stage model. In a more recent study by Hardin and Carr (2006), the rent determinants for neighborhood center and community center are compared and the existence of retail center property type differences in rent determinants is evaluated.

Most of the empirical investigations of retail rent are conducted in Western countries, empirical studies on retail rents are relatively limited in Hong Kong due to the difficulty in accessing adequate data on retail rents. In a study by Tay, Lau and Leung (1999), the generality of previous empirical findings on the determinants of retail rent in shopping center is accessed, using the sample data obtained in Hong Kong. The result reveals that most of the previous findings are applicable in Hong Kong, except the age of the center and lease provisions, which contradict the previous findings. Hui, Yiu and Yau (2007) investigate the effect of shopping centers' market position on their rents. Using the data obtained from Link, a real estate investment trust in Hong Kong, the shopping centers under investigation are divided into four categories, District center, Local center, Estate center and Shop respectively. The regression results reveal that District center gets the highest average rent.

2.3 Review of related studies

Ownby et al. (1994) report an analysis of the opinions of practitioners on the impact of location variables on the neighborhood center rent. These practitioners consider the presence of competing center within the trade area to be negative to the neighborhood center's rental rate. However, this result provides no empirical evidence to support their findings. Also, this study focuses only on the impact to the neighborhood centers. The extent to which the findings are representative enough to ascertain the impact of location

variables on the shopping center is in doubt. In addition, as mentioned in the paper, the research only reflects the opinions of real estate professional, but not the retail tenants of the neighborhood centers. The tenants might have different opinions toward the location variables.

Hardin and Wolverton (2000, 2001) use a relatively large data set to investigate the determinants of neighborhood retail rent. The results of these two studies reveal that proximity of neighborhood center to high order malls provides a positive effect on the rent of the center. However, as the target of the studies is the neighborhood center, the generality of their results are hence confined to the impact of high order retail centers on the neighborhood center. There remain some questions in doubt, like does the effect exist in other retail facilities sub-types? A subsequent study by Harden Wolverton and Carr (2002) provides a similar analysis for community center. Still, no general conclusion can be drawn for the impact of nearby high order mall on the shopping centers. In addition to these, the results of the abovementioned studies do not provide a comprehensive explanation to justify the observations as well.

Chung and Kalnins (2001) conduct a study to investigate the impact of proximity to competition on the performance of hotels in Texas. The results reveal that the presence of competitors nearby may not be detrimental, but may be beneficial instead. The performance of smaller hotels is better when in closer proximity to large, chained hotels, as the small, independent hotels can enjoy the externalities generated by the large, chained hotels. Though not a retail study, the study gives a preliminary insight to ascertain the positive proximity impact of high order mall on the shopping center rent.

Table 2.1 Summary of Literature Review

Title	Source	Author	Summary
Central Place Theory			
The Geography of Market Centers and Retail Distribution	Englewood Cliffs, NJ: Prentice-Hall, 1967	Berry, B.J.	The author provides an early test of the single purpose trip hypothesis in Central Place theory, by investigating the consumer's purchasing behavior in rural Iowa. The results provide support to the hypothesis in the theory.
Some Spatial Characteristics of Iowa's Dispersed Farm Population and Their Implications for the Grouping of Central Place Functions	Economic Geography, 1966, 42, 261-72	Golledge, R. S., Rushton, G. and Clark, W. A.	The paper empirically tests the nearest center hypothesis of the Central Place Theory. The result reveals that consumers do not always purchase goods at the nearest center.
Formulation and Test of a Normative Model for Spatial Allocation of Grocery Expenditures by a Dispersed Population	Annals of the Association of American Geographers, 1967, 57, 389-400	Rushton, G., Golledge, R. S. and Clark, W. A.	The paper provides a more focused study of the nearest center hypothesis, and the result shows that consumers do travel further for some goods and services, but not only the nearest center.
Spatial Diversification and Multipurpose Travel: Implications for Choice Theory	Geographical Analysis, 1980, 12, 245-57	Hanson, S.	The author empirically analyzes the consumer shopping behavior and definitely observes multi-purpose shopping behavior, using data collected in Sweden. She hence rejects the single purpose trip assumption in Central Place Theory

A Model Of the Demand for Retail Facilities, Incorporating Multistop, Multipurpose Trips	Geographical Analysis, 1981, 13, 134-48	O'Kelly, M. E.	The author, using data obtained from a household travel survey, demonstrates that multi-purpose shopping trips do exist, which is contrary to the assumption of Central Place Theory.
Homogeneous Retail Agglomeration			
The Theory of Monopolistic Competition: A Reorientation of the Theory of Value	Cambridge, MA: Harvard University Press, 1933	Chamberlin, E. H.	The paper challenges the Hotelling's suggestion that that a third seller would locate next to the first two in the center of the market. He argues that a dispersed equilibrium will cause, instead of a stable clustered equilibrium
Some Notes on Duopoly and Spatial Competition	Journal of Political Economy, 1937, 45, 145-86	Lerner, A. P. and Singer, H. W.	The authors study the Hotelling's suggestion of existence of agglomeration equilibrium, but the result shows that it is invalid in the case of three firms.
The Principle of Minimum Differentiation Holds under Sufficient Heterogeneity	Econometrica, 1985, 53, 767-81	De Palma, Ginsburgh, A. V., Papageorgiou, Y. Y. and Thisse, J. F.	The authors reformulates Hotelling's model and show that when sufficient heterogeneity is integrated in consumer taste and retail products, the principle of minimum differentiation can be maintained.
The Principle of Minimum Differential Revisited: Some Developments in the Theory of Spatial Competition	Review of Economic Studies, 1975, 42, 27-49	Eaton, B. C. and Lipsey, R. G.	The paper shows that a stable clustered equilibrium does not exist under either a one-dimensional or a two dimensional market space.
An Economic Theory of Central Places	Economic Journal, 1982, 92, 56-72	Eaton, B. C. and Lipsey, R. G.	The authors demonstrate that when demand is responsive to delivered price, firms in the interior of a

			one-dimensional market will be equally spaced. Hence, even Hotelling's model is so amended, a clustering of even two firms cannot occur.
The Impact of Uncertainty Upon Location	Cambridge, MA: MIT Press, 1972	Webber, M. J.	The author shows that when uncertainty is introduced into the Hotelling's model, a stable agglomerated central market does exist.
Comparison Shopping and the Clustering of Homogeneous Firms	Journal of Regional Science, 1979, 19, 421-35	Eaton, B. C. and Lipsey, R. G.	The authors find that local clustering of firms can serve a socially useful purpose by helping to minimize the transportation cost between firms and comparison shoppers, which is in contrast to the Hotelling's model.
The Concept of Mass in Intra-Urban Shopping	Journal of Marketing, 1967, 31, 37-42	Bucklin, L. P.	The author classifies comparison shopping using the types of goods purchased, namely full search, directed search and causal search respectively. The result reveals that for full search goods, the transportation involved in making multi stops at different located centers often outweighs the expected price savings of the shopping experience.
Demand Externality			
Consumer and Producer Behavior in a Multipurpose Shopping Environment	Geographical Analysis, 1990, 22, 70-93	Ingene, C. A. and Ghosh, A.	The authors propose that retail center specific attributes, such as tenant mix and center design can affect retail performance, and this proposition then forms the basis for demand externality theory.
Image Inputs to a Probabilistic	Journal of Marketing, 1976,	Stanley, T. J. and	The authors investigate the effect of image of

Models: Predicting Retail Potential	40, 48-53	Sewall, M. A.	supermarket, making use of the data collected by personal interviews. The result reveals that stores with better image can draw customers from longer distance.
Image as a Component of Attraction to Intraurban Shopping Areas	Journal of Retailing, 1980, 56, 77-93	Nevin, J. R. and Houston, M. J.	The authors empirically study the effects of tenant mix and shopping center image. The result shows that anchor department stores and tenant mix are two important factors for drawing customers to the shopping center.
Retail Leasing Behavior with Anchor Tenant Externalities	Ph. D. dissertation, University of Wisconsin-Madison, 1991	Eppli, M. J.	The author empirically examines the effect of size and image of anchor tenants on the non-anchor tenants in regional shopping centers. The result reveals that there is a positive relationship between the image of anchor store and the non anchor tenant sales.
Inter-Store Externalities and Space Allocation in Shopping Centers	Journal of Real Estate Finance and Economics, July 1993, 7, 5-16	Brueckner, J. K.	The author demonstrates that there are both anchor and non-anchor demand externalities. Hence, the mall owners will maximize their profit by allocating space to various types of tenants.
Optimal competition and Allocation of Space in Shopping Centers	Journal of Real Estate Research, 1998, 16, 113-26	Miceli, T. J. and Sirmans, C. F. and Stake, D.	The authors show that profit maximizing developer may allow within center competition, as the presence of shopping externalities and increased customer traffic can increase the center's overall profit.
Retail Rent			
Retail Leasing: The Determinants of Shopping	Journal of the American Real Estate and Urban Economics	Benjamin, J. D., Boyle, G.. W. and	The paper provides the first empirical analysis of variations in rents across the leases. The results reveal

Center Rents	Association, 1990, 18(3), 302-12	Sirmans, C. F.	that there is a trade off between percentage rent and base rent, and the base rent for leases is affected by tenant profile
The Determinants of Shopping Center Rents	Journal of Real Estate Research, 1993, 8, 107-15	Sirmans, C. F. and Guidry, K. A.	The paper is the first paper that investigates the determinants of all types of shopping centers. The result shows that the rent of shopping center is affected by the center size, design, age, location etc.
The Effect of Anchor Tenant Loss on Shopping Center Rents	Journal of Real Estate Research, 1994, 9, 99-110	Gatzlaff, D. H., Sirmans, G.. S. and Diskin, B. A.	Both of the studies emphasize on the importance of anchor tenant in a shopping center. The papers find that loss of anchor tenants will impact the vacancy and rent of the center.
Suffering the loss of an Anchor Tenant," Megatrends in Retail Real Estate.	Research Issues in Real Estate Vol. 3, pp 261-276 J.D. Benjamin (ed.), Norwell, MA: Kluwer	Sirmans, G..S., Gatzlaff, D. H. and Diskin, B. A.	
The Effect of Location Variables on the Gross Rents of Neighborhood Shopping Centers	Journal of Real Estate Research, 1994, 9, 111-124	Ownby, K. L., Davis, K. and Sundel, H. H.	The paper presents a study of real estate practitioner's opinions on the determinants of neighborhood center rent. The paper reveals some influence of location variables, like the number of competing neighborhood center nearby etc, on the neighborhood center's rent.
An Empirical Analysis of the Retail Tenant Mix	Journal of Real Estate Research, 1998, 15(3)	Gerbich, M.	The author empirically tests the significance of types of tenant on the base rents of the shopping centers. The findings reveal that type of tenants is a key determinant of the base rents of the center.

Micro-Market Determinants of Neighborhood Center Rental Rents	Journal of Real Estate Research, 2000, 20(3), 299-322	Hardin III, W. G. and Wolverton, M. L.	The paper investigates the determinants of neighborhood center rental rates. The result shows that primary trade area and property specific characteristics are the primary determinants of center vacancy rate and rental rates.
Neighborhood Center Image and Rents	Journal of Real Estate Finance and Economics, 2001, 23(1), 31-46	Hardin III, W. G. and Wolverton, M. L.	The impact of neighborhood center image on the rental rent is empirically modeled and tested. The results show that the multi-purpose variables, as well as the image related facilities specific variables are important determinants of the neighborhood center rent.
An Empirical Analysis of Community Center Rents	Journal of Real Estate Research, 2002, 23:1/2, 163-179	Hardin III, W. G. , Wolverton, M. L. and Carr, J.	The study empirically examines the determinants of community center rent. The result shows that rent is influenced mainly by trade area purchasing power, center age.
Disaggregating Neighborhood and Community Center Property Types	Journal of Real Estate Research, Apr-June 2006, 28(2), 167-193	Hardin III, W. G. and Carr, J.	In this paper, the rent determinants for neighborhood center and community center are compared. It is conclude that the two types of center can be disaggregated into separate product types
The Determination of Rent in Shopping Centers: Some Evidence from Hong Kong	Journal of Real Estate Literature, 1999, 7, 183-196	Tay, R. S., Lau, C. K. and Leung, M. S.	The paper assesses the generality of previous empirical findings on the determinants of retail rent in shopping center, using the data collected in Hong Kong. It is found that most of the determinants identified are consistent with previous findings, except the center age,

			and the lease provisions
Retail Properties in Hong Kong: a rental analysis	Journal of Property Investment and Finance, 2007, 25(2), 136-46	Hui, E. C. M., Yiu, C.Y. and Yau, Y.	In this paper, the authors investigate the effect of shopping centers' market position on their rents. Using the data obtained from Link, a real estate investment trust in Hong Kong, the regression results reveal that District center gets the highest average rent among the center types.
Related study			
Agglomeration Effects and Performance: A Test of the Texas Lodging Industry	Strategic Management Journal, 2001, 22, 969-988	Chung, W and Kalnins, A	The paper investigates the impact of proximity to competition on the performance of hotels in Texas. The results reveal that the presence of competitors nearby may not be detrimental, but may be beneficial instead. It is because the small hotels can gain positive externalities from large hotels.

Chapter 3: Classification of Shopping center in Hong Kong and definitions of terms

Before attempting to investigate the proximity impact of high order mall on the shopping center rent, the classification system of shopping center and definitions of some important terms used in the study are given first. The information is important as it can affect the interpretation of results in the study. Some main features relating to the retail industry in Hong Kong are provided as well, which are useful references for understanding the findings in the study.

3.1 Definition of shopping center

A shopping center can be defined as "a planned group of connected retail stores, usually with an attached parking area, specially developed on a parcel of private property and managed by a single organization"[3].

3.2 Advantages of enclosed shopping center

There are several advantages of enclosed shopping center over other retail facilities. The wide range of products and services provided in the shopping center is inevitably an attraction, as it offers huge assortments for the customers. Combining many retailers in a shopping center can also create a synergy that attracts more customers than if the retailers are located separately. Furthermore, the retailers and their customers need not to worry about the external environment. The controls of temperature, humidity, together with high standard of interior finishes make the enclosed center a more pleasant place for shopping.

[3] Shopping Mall Studies, by the American Studies at Eastern Connecticut State University

3.3 Shopping center classification

Shopping center classification is complex and uncertain. There are much of the debates over the years concerning the classification of shopping center. As mentioned before, following the change of shopping habits, many people nowadays go shopping in shopping center, and hence shopping centers of different types emerge to cater for the increasing demand of people. However, shopping center formats have taken on a confusing array of identities over the years (Delislie, 2005). There is no general agreement about the number of distinct types of shopping center, and how individual centers should be assigned to the various categories.

In fact, shopping centers can be primarily classified by their size, populations served, the variety of shops that exist and the availability of other attractions and facilities. Though there is no agreement about the types of shopping center, shopping centers in Hong Kong can be generally classified into four main types, namely Local center, District center, Regional center, and Metropolitan center respectively[4]. Local center and District centers serve mainly the local resident, while the Regional and Metropolitan centers serve a larger catchment population, and hence provide a wider range of goods and services. Table 3.1 shows a general hierarchy of shopping centers in Hong Kong, incorporating the information from the Hong Kong Planning Standard and Guidelines, as well as National Research Bureau (NRB) Online.

[4] Hong Kong Planning Standards and Guidelines, Planning Department, HKSAR

Table 3.1 General Hierarchy of Shopping Centers in Hong Kong

Types of shopping center	Internal Floor Area (m^2)	Catchment population	Description
Metropolitan center	>60,000	Serve the population of Hong Kong as a whole	Metropolitan centers serve Hong Kong as a whole and tourists to Hong Kong (e.g. Central, Tsim Sha Tsui and Causeway Bay). They also provide territory-wide entertainment and social facilities
Regional center	27,000-60,000	250,000 to 1,000,000	Shopping centers which fulfill a regional function. They are typically provided outside the Metropolitan area in the new town centers (e.g. Tsuen Wan, Sha Tin, Tai Po, Fanling/Sheung Shui, Yuen Long and Tuen Mun)
District center	10,000-27,000	50,000 to 250,000	Medium-scale shopping centers of town-wide or district significance (e.g. Wan Chai in the urban area and Kam Tin in the rural area)
Local center	Less than 10,000	less than 50,000	Small-scale concentrations of shops which serve a localized catchment population (e.g. Fung Tak Estate and Tai Yuen Estate), and support local retail services and restaurant establishments

Sources: Hong Kong Planning Standard and Guidelines, National Research Bureau (NRB) Online.

3.4 Definition of high order mall

As the focus of the study is to investigate the proximity effect of high order mall on shopping center rent, the definition of high order mall is explained in order to assist the interpretation of findings in the study.

There is no general definition of high order mall in the retail industry. In fact, the term "high order mall" is rather subjective, and its meaning may vary between different people.

Impression should be a primary factor for the people to determine the order of a shopping center. In retail industry, the shopping centers can be classified into different types mainly by the total size, the catchment population it serves, and the variety of shops in the shopping centers. As there is no agreed definition of high order mall in the industry, the author tries to develop a reasonable and objective definition, with reference to the opinions from experienced retail researcher[5]. Two primary factors are taken into account to develop a definition of high order mall, including respectively the total Internal Floor Area (IFA), and the variety of shops exist in the shopping center. The catchment population is omitted because it is difficult to determine exactly the population a shopping center serves.

The high order malls are hence defined as those with total IFA over 300,000 square feet (27,000 square meter), and have more than 10 different types of retailer existed in the center[6].

3.5 Definition of trade area

Retailers estimate the demand for a new location by defining its trade area and then estimating how much people will spend within the trade area. Levy and Weitz (1998) define the trade area to be a contiguous geographic area that accounts for the majority of a store's sale and customers. The boundaries of the trade areas surrounding a site can be determined by a number of factors, such as type of retail center, location of competing retail facilities, population concentration etc. Trade areas can be divided into two or three

[5] The author would like to thank Dr Edward C.Y. Yiu, Assistant Professor in the Department of Real Estate and Construction, the University of Hong Kong, for his valuable opinions. Dr Yiu is experienced in retail research. He is also the corporate member of Institute of Shopping Center Management, 2006.

[6] With reference to the retail services category defined by Hong Kong Retail Management Assoication, all retailers in Hong Kong are classified into 11 types, including beauty products and cosmetics, catering food, department stores, electronic and electrical appliances, fashion and accessories, furniture and home accessories, supermarkets and convenience stores, watch and jewellery, specialty shop, entertainment and others.

zones and are in the form of concentric polygons. The primary trade area is the geographic area from which the store or shopping center derives 60-65 percent of its customers. The secondary trade area is the area that generates about 20 percent of the sales of a store. The tertiary trade area usually includes customers who occasionally shops at the store or shopping center. It generates the remaining retail sales after the primary and secondary trade area.

3.6 Main features of retail industry in Hong Kong

The extremely spatial concentration of the market, the severe fragmentation imposed by physical barriers, and the focus of market access by public transportation are all important factors in determining the spatial structure of retail activity in Hong Kong. (Simmons and Chan, 1992) The author has identified three main features of retail industry in Hong Kong.

Since the 21st century, Hong Kong retail industry has experienced a change of targeted customers from mainly Hong Kong people to both Hong Kong residents and visitors from mainland China. The provisions of a wide range of products and no goods and services taxes make Hong Kong a well-known "shopping paradise" in the world. There is a considerable number of visitors coming to Hong Kong each year, and the majority of visitors come from mainland China.[7] Thus, the purchasing power of the visitors from mainland China provides a huge source of demand for retail industry in Hong Kong.

Secondly, though traditional street frontage retailing has remained important in the older shopping areas, its significance has declined in new development areas due to the

[7] With reference to the statistics published by Census and Statistics Department, there were a total of 25,251,000 visitors coming to Hong Kong in 2006, in which 13,591,000 (54%) of the incoming visitors came from mainland China.

emergence of more new and trendy shopping center. Along with the economic development and the change in consumer culture, shopping centers have gradually replaced the traditional street frontage retailing, department stores and retail outlets and become the major venues for shoppers in Hong Kong

Lastly, the spatial distribution of convenience goods is highly localized to serve the neighborhood population, while massive region-serving shopping goods concentrations occur in some major shopping districts, like Central and Causewaybay on Hong Kong Island, Tsim Sha Tsui and Mongkok in Kolwoon. Along with the improvement of transportation systems, the development of planned shopping centers in new towns is also a trend, for example, Metro Plaza in Tseung Kwan O etc. With reference to the Hong Kong Property Review 2007 Preliminary Findings, about 44% of the new commercial premises supply in 2007 will be located in the new towns in New Territories.

Chapter 4: Hypothesis, Methodology, Variables and Data

This chapter is divided into four parts. Section 4.1 provides a deduction of hypothesis in this study. Section 4.2 illustrates the methodology used in the study. Section 4.3 describes the data collected in the study. Section 4.4 explains the variables selected in the empirical models.

4.1 Hypothesis deduction

The hypothesis in the study is that proximity of a shopping center to high order mall brings a positive effect on the rental income of the shopping center. A comprehensive explanation of the proximity effect of high order mall to the shopping center rent is scarce in the previous literatures. Thus, the deduction of hypothesis will be given before we investigate further.

Basic Economic model of spatial competition gives insight that firms which locate more distantly from each other can enjoy profitable local monopolies. Conversely, proximity to competitors is usually associated with greater competition. Owing to this, it is not hard to expect that the proximity of shopping center to high order mall, which implies the existence of more shopping centers in a trade area, leads to reduced retail rents or sales. Shopping center in close proximity to high order mall inevitably incurs competition between them. The level of competition can affect the size, as well as the demand in a trade area. If two shopping centers are located close to each other, their respective trade areas will shrink since they offer similar retail services for the customers. The benefit of the shopping center is hence decreased by “reducing each share of the cake”. Also, the shrinkage of trade area depends on the competitiveness of a shopping center. High order mall has favorable retail image, and it can offer a variety of goods to the customers. Thus,

it renders the shopping center in a disadvantageous status in the competition.

However, it is suggested in this study that proximity to high order mall does not necessarily be adversarial. The shopping center located near to high order mall can enjoy external benefits. The external benefits are collectively termed as “agglomeration gains”.

Proponents of retail demand externalities believe that in large shopping centers, low order good retailers and smaller retailers receive demand externalities from the additional traffic that is generated by high order anchor retailer. The rent of smaller non-anchor tenant increases when an anchor tenant is present in a shopping center. In fact, an anchor tenant in a shopping center is more or less the same as a high order mall in a trade area. High order mall is a magnet which draws customers to a trade area. The customer draw of high order mall depends primarily on its retail image. Favorable retail image, which results principally from the anchor tenants existed, a greater variety of products, better shopping environment of the mall and other unique features, can hence draw customers from greater distance. The positive demand externalities generated by the mall can spill over to the proximate shopping center, and the center is hence benefited from the additional pedestrian traffic.

Proximity to high order mall also brings along multipurpose shopping benefits to the shopping center. The clustering of shopping centers of different types in a trade area can be explained by the Central Place Theory through the reduced travel cost of multipurpose shopping. Today most customers combine their shopping trips into multipurpose shopping to include the purchase of a variety of retail goods. This can help to reduce their total travel costs of shopping. The existence of more shopping centers in a trade area can also reduce the search cost of the customers for products. Shopping center near to high order

mall is hence benefited from the effective extension of maximum range of potential center customers.

The proximity of shopping center to high order mall can hence incur both competition and agglomeration gains. It is proposed in this study that the gains from agglomeration can outweigh the loss from competition. The rationale is that high order mall and shopping center are positioned differently to substantiate their survival in a trade area. Their heterogeneity in market position, products and services offered may render the level of competition among them limited. On the other hand, the high order mall may benefit the shopping center by providing additional pedestrian traffic and creating new purchasing power through pulling customers from other catchment areas. The agglomeration gains outweigh the competition loss. Hence, the proximity of shopping center to high order mall is beneficial and provides positive impact to the shopping center rent.

4.2 Methodology

4.2.1 Multiple regression analysis

This study aims at empirically testing the proximity effect of high order mall on the shopping center rent. As there are totally 18 independent variables in the model, multiple regression analysis is used to study and analyze the effect. The general objective of regression analysis is to model the relationship between a dependent variable and one or more independent variables. A general multiple regression model, which relates a dependent variable y to k independent variables x_1, x_2…….x_k, is given by the model equation

$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots \beta_k x_k + \varepsilon$

The simplest and most common method of estimating the parameters of the regression model is the Ordinary Least Squares (OLS) technique. It can minimize the residual sum of squares (sum of the squares of the differences between the actual and forecast values of dependent variable).

4.2.2 Choice of functional form

The functional form of the regression equation depends on the nature of the relationship. The usual forms include linear, semi-logarithm or logarithm. In this study, functional form of the empirical models can be deduced from a prior knowledge of the relationship between dependent and independent variables. Consistent with the previous empirical studies of determinants of shopping center rent[8], the semi-logarithm function form is used in this study.

4.2.3 Test statistics

There are several test statistics that can be determined from the regression analysis, and the information is crucial to evaluate and interpret the empirical results.

Coefficient of determination (R^2)

The coefficient of determination of a regression analysis indicates the proportion of variation in the dependent variable that can be explained by the variation in the independent variables. The value of R^2 must be between zero and one. The higher the value of R^2, the higher is the explanatory power of the estimated model.

[8] For example, Benjamin, Boyle and Sirmans (1990), Sirmans and Guidry (1993), Hardin and Wolverton (2000, 2001) and others

t-Statistic

The t-statistics of the independent variables are used to test the significance of the effect of the independent variable on the dependent variable. If the t-statistic is larger than the critical value for a given significance level and degree of freedom, then the independent variable is said to be significant at a certain significance level. The larger the t-statistic, the more significant is the variable.

F-Statistic

F-Statistic is used to test the significance of the R^2 Statistic. Also, it can also be used to test the null hypothesis that the regression coefficients are equal to zero. If it is larger than the critical value for a given significance level and degree of freedom, the null hypothesis is rejected.

The average shopping center rent is defined as the dependent variable, while distance to the nearest high order mall or number of high order mall in the primary trade area, and some primary determinants of shopping center rent act as the independent variables. The primary determinants of center rent are used as control in the test. The reasons and criteria for choosing the included determinants will be explained and clarified in the later passage.

4.3 Data

4.3.1 Sources of data

The rental information of the shopping centers is obtained from the Link, a real estate investment trust in Hong Kong. Rental information of 151 retail facilities of different types was released through the global offering of the Link. All the related information collected, unless specified, is as at 31st July, 2005. In addition to this, other information on different attributes, which may affect the rent of the shopping center, is obtained from the following sources:

1) Centamap
2) Maps published by the Survey and Mapping Office of the Lands Department of the HKSAR Government
3) Websites of Census and Statistics Department, Rating and Valuation Department
4) Websites of shopping centers

Site visits to the shopping centers are carried out, in order to confirm the accuracy of data obtained from the Link, as well as the abovementioned sources,

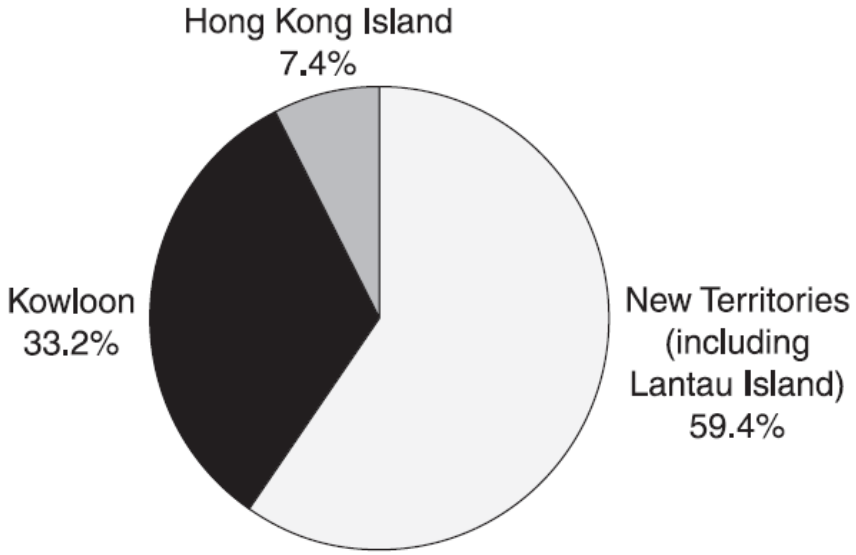
4.3.2 Overview of the Link

In November 2005, the Hong Kong Housing Authority divested 180 retail and car parking facilities to The Link Real Estate Investment Trust (The Link REIT). The Link is the first REIT listed in Hong Kong. Following the acquisition of the properties, it makes the Link become the largest owner of retail properties in Hong Kong. The company's portfolio consists of retail spaces that have Internal Floor Area (IFA) of approximately 960,000

square meters and around 79,000 carparking spaces.

With reference to the Link, of the 151 retail facilities, 86 are located in the New Territories (including Lantau Island), 50 in Kowloon and 15 on the Hong Kong Island. As at 31 July 2005, the retail facilities located in New Territories, Kowloon and Hong Kong Island accounted for 59.4%, 33.2% and 7.4% respectively of the total IFA of the retail facilities.

Figure 2 Chart showing the distribution of retail facilities in terms of IFA



Source: The Link (2005, pp112)

Referring to the size, catchment, range of retailers or the availability of other attractions and facilities in the retail properties, the Link defines its own hierarchy to classify different types of retail properties in the portfolio. Table 4.1 describes the key criteria of the classification system used in the Link.

Table 4.1: Hierarchy of Retail Facilities Held Under the Link

Type of facilities	Size	Description
District centers	Typically more than 10,000 m^2, although certain smaller centers may also exhibit the characteristics of District center	- Typically larger and newer, part of larger housing estates - Catchments draw from the adjacent housing estates, and more broadly from within the district with over 50,000 population - May include some branded and popular retailers, including fashion, jewellery and gift vendors - Typically anchored by one or two supermarket chains, market stalls, branded/chain fast food outlets and/or large Chinese restaurants
Local centers	Typically between 5,000 and 10,000 m^2	- Typically smaller in size than District centers; purposely built and designed to cater to the requirements of the adjacent housing estates' residents - Catchments consist of approximately 25,000 to 50,000 people - Typically contain trades that cater to the daily needs of the residents, such as supermarkets, market stalls, local restaurants and convenience stores
Estate centers	Typically less than 5,000m^2	- Typically comprise a collection of shops on the ground floors and podiums of domestic residential buildings - Designed to meet the basic shopping needs of the particular estate - May not have traditional enclosed shopping center layouts

Shops	Typically less than 1,000m^2	- Collection of ancillary shops serving the residents and users of the carpark facilities

Source: The Link (2005, pp120)

The shopping centers held under the Link are originally developed to serve the needs of the local residential population. The major customers of the shopping centers held under the Link are hence the residents from nearby public housing estates. Thus, though privatized, many shoppers still consider them as quasi-public shopping centers. As the focus of the study is the proximity impact of high order mall on the shopping center rent, only 119 of the retail properties held under the Link are included in the empirical study. Shops are excluded from the study, because they do not possess the nature of shopping center, with reference to the previously mentioned definition of shopping center.

4.4 Selection of variables

The focus of this study is to investigate the proximity effect of high order mall on the shopping center rent. The selection of variables in this study is mainly based on the previous literatures. Variables identified to be significant by previous studies are included in the empirical models. It is true that the inclusion of more variables may increase the explanatory power of the empirical models. However, this will lead to an increase in the complexity of the analysis as well (Mason & Quigley, 1996). Therefore, there is a trade-off to incorporate the relevant variables in the models. Table 4.2 shows the list of variables used in the models and their corresponding definitions.

Table 4.2: Variables Used in the Empirical Models

Variables	Unit of measure	Descriptions
Dependent variable		
ln (RENT) (LN_RENT)	HK$ per m^2 p.a.	Natural logarithm of the base rent per square meter per month of the shopping centers
Independent variables		
Physical Attributes		
Age (AGE)	years	Age of the shopping centers
ln (IFA) (LN_IFA)	m^2	Natural logarithm of the internal floor area of the shopping centers
Occupancy rate (OCR)	%	OCR= (Occupied shops / No.of shops) x 100%
Market position Attributes		
District center (DC)	dummy	DC = 1 if the shopping center is a District center, zero otherwise
Estate center (EC)	dummy	EC = 1 if the shopping center is a Estate center, zero otherwise
Location Attributes		
Distance to the nearest railway station (RAILWAY_D)	km	Direct distance of the shopping center to the nearest railway station
Hong Kong Island (HKI)	dummy	HKI = 1 if the shopping center is located on Hong Kong Island, zero otherwise
Kowloon East (KLE)	dummy	KLE = 1 if the shopping center is located in Kowloon East
Kowloon West (KLW)	dummy	KLW = 1 if the shopping center is located in Kowloon West
Kwai Chung (KC)	dummy	KC = 1 if the shopping center is located in Kwai Chung, Tsuen Wan or Tsing Yi
Shatin and Ma On Shan (ST)	dummy	ST = 1 if the shopping center is located in Shatin or Ma On Shan
Tai Po (TPO)	dummy	TPO = 1 if the shopping center is located in Tai Po, Fanling or Sheung Shui
Tsueng Kwan O (TKO)	dummy	TKO = 1 if the shopping center is located in Tsueng Kwan O
Tuen Mun (TM)	dummy	TM = 1 if the shopping center is located in Tuen Mun
Tung Chung (TC)	dummy	TC= 1 if the shopping center is located in Tung Chung

Yuen Long (YL)	dummy	YL = 1 if the shopping center is located in Yuen Long or Tin Shui Wai
Proxies for Hypothesis		
a) Distance to the nearest high order mall (MALL_D)	km	Direct distance to the nearest high order mall
b) Number of high order mall in primary trade area (MALL_NO)	each	Number of high order mall in primary trade area

4.4.1 Dependent variable

Consistent with previous literatures, LN_RENT is defined as the natural logarithm of the base rent per square meter per month of the shopping centers held under the Link[9]. With reference to the Link (2005, pp282), base rent means the standard rent payable under the lease, exclusive of any additional turnover rent and other charges and reimbursements. Unit base rent is used, rather than base rent of shopping center, because it is found that there is a high correlation between base rent and size of the shopping center. This may lead to inapplicability of t-Statistics and difficulty in the interpretation of regression coefficient. The estimated equation may be misleading, and hence the interpretations of results may no longer valid. On the other hand, the similar problem does not exist in unit base rent. The use of unit rent in the empirical study of retail activity also gains support from the abovementioned previous literatures.

4.4.2 Independent variables

The independent variables used in the empirical model can be classified into physical attributes, market position attributes and location attributes respectively. There are totally 18 independent variables selected to study their effects on the rent of shopping centers

[9] The rental information collected is referred for the month of July, 2005.

held under the Link. The selected variables in each attribute are described below.

Physical attributes

Age, Natural logarithm of internal floor area and Occupancy rate are the set of variables included in the physical attributes. The attributes can reflect the physical ability of a shopping center to attract customers and generate retail sales. These variables can in turn act as proxies for the customer drawing power of a shopping center.

Age (AGE)

As the shopping center deteriorates with time, the age of it can be regarded as a proxy for the physical conditions of shopping centers. The age, in years, of a shopping center is interpreted as the difference in number of years between the opening year of the shopping center and year 2005. Age is expected to have an inverse relationship with the rent of shopping center. The reasons are twofold. Firstly, as the styles of shopping center change over time, new and modern centers are expected to attract more customers, and hence extract higher rents from tenants. Alternatively, older shopping centers may suffer from deterioration of facilities, an inappropriate tenant mix. Thus, lower rents are expected for older centers.

Natural logarithm of Internal Floor Area (LN_IFA)

Internal Floor Area (IFA), measured in square meters, is interpreted as the internal area available for the exclusive use of the occupier of a building, but excluding all common or

service areas used in common for the building as a whole[10]. It is used as a proxy for the size of the shopping center. Consistent with Tay, Lau and Leung (1999), the natural logarithm form of the IFA is used in the study. The variable is expected to be positively related with the shopping center rent. Sirmans and Guidry (1993) state that larger centers are expected to have a higher degree of customer drawing power due to their diversity. Tay, Lau and Leung (1999) also mention that larger centers have more market power and thus greater ability to extract consumer surplus. Thus, larger center can extract a higher rental rate from tenants.

Occupancy rate (OCR)

Occupancy rate, in percentage, is interpreted as the number of occupied shops divided by the total number of shops in the shopping center. Occupancy rate is expected to be positively related with the rent of the shopping center. Higher occupancy rates are usually associated with the shopping centers that are capable to extract higher rental rent from the tenants. Higher occupancy rate implies that the shopping center is competitive enough for the retailers to survive. Hence, the rental rate of a competitive shopping center must be higher.

Market position attributes

Retail facilities are positioned differently in order to substantiate their survival in the market. Market position can affect the catchment population and the degree of positive externalities in a shopping center. For example, Estate center mainly serves for local residential population and predominantly features some small convenience shops. On the

[10] With reference to the definition used by the Link (2005, pp.282)

other hand, District center provides a much wider range of goods and has a larger catchment population. The attributes are hence used to capture the effect of market position on the shopping center rent. The two dummy variables involve the classification of shopping centers held under the Link into three types, including District center (DC), Local center (LC), and Estate center (EC) respectively, with reference to the hierarchy of retail facilities used by the Link. The omitted variable in the study is Local center (LC). It is expected that shopping center positioned to have larger catchment population can generate a higher rental rate from the tenants.

Location attributes

It has often been said that the three most important properties of a retail store are location, location, and location (Jones and Simmons 1990). Alexander and Muhlebach (1992) also state that a right location is crucial for the success of a shopping center. Therefore, location is undoubtedly a major determinant of a successful shopping center. The site must be highly visible to shoppers, as well as easily accessible. The variables included in the location attributes can be classified into continuous and dummy variables.

Continuous variable

Distance to the nearest railway station (RAILWAY_D)

The accessibility of a shopping center refers to the ease of customers get into and out of it. Easy access is critical for the success of a shopping center, since it can draw more customers to the center and hence generate more retail sales. (National Economic Development 1971) In order to evaluate the accessibility of a shopping center, it is

reasonable to consider the number of traffic opportunities for customers to travel to and from other locations.

Regardless of the importance of accessibility, the correlation between the rental rate and accessibility, particularly by public transport, of the shopping center has received relatively little attention in the previous literatures (Tay, Lau and Leung, 1999). Accessibility by public transport is a major consideration for shoppers in such highly urban and congested city as Hong Kong. The research findings of a recent study show that convenient transport is the major criteria for the shoppers in selecting the shopping mall in Hong Kong[11]. Railway, including the Mass-Transit Railway, East Rail, West Rail and Ma On Shan Rail, is the major public transport, which covers a large extent of area in Hong Kong. The extensive railway network provides a convenient way for shoppers to go to the shopping centers. Thus, based on an implicit assumption that people go to the shopping center by railway transportation only, the distance to the nearest railway station can be reasonably used as a proxy for the accessibility of a shopping center.

The distance from the shopping center to the nearest railway station, measured in kilometers, is interpreted as the direct point to point distance measured from the map. Shopping centers with closer proximity to the railway stations are expected to be more attractive, and hence can extract higher rent from the tenants.

One remarkable point is that five observations in the sample are excluded from the empirical study. These observations are the shopping centers located in the Southern District of Hong Kong Island, where there is no provision of railway transportation.

[11] CUHK MSc Programme in Marketing Survey on Hong Kong Shopping Malls Investigates whether Aspirations of Hong Kong Shoppers and PRC Tourists are Satisfied (2006)

Dummy variables

The ten dummy variables involve the division of the shopping centers held under the Link into eleven districts, *Hong Kong Island*, *Kowloon West*, *Kowloon Central*, *Kowloon East*, *Kwai Chung (including Tsuen Wan and Tsing Yi)*, *Shatin and Ma On Shan*, *Tai Po (including Fanling and Sheung Shui)*, *Tsueng Kwan O*, *Tuen Mun*, *Tung Chung*, *Yuen Long (including Tin Shui Wai)*. The omitted variable in the study is *Kowloon Central*. The main idea of dividing the shopping centers according to their locations is to supplement the factor of location and control for additional location factors not specified in the study. As the focus of this study is the proximity effect of high order mall to the shopping center rent, these dummy variables are used to capture the effect on the rental rate of shopping centers due to their differences in locations.

Proxies for Hypothesis

a) *Distance to the nearest high order mall* (MALL_D)

The distance to the nearest high order mall, measured in kilometers, is interpreted as the direct point to point distance from the shopping centers held under the Link to the nearest high order mall. This variable can quantify the effect of proximity to high order mall, as it allows measurement of the expected marginal benefit of proximity to high order mall, keeping other variables constant. As previously explained in the hypothesis deduction, it is expected that shopping center in closer proximity to high order mall can generate higher rental rate from the tenants. A significant negative sign on the distance to the nearest high order mall variable would therefore confirm the hypothesis in the study.

b) *Number of high order mall in the primary trade area* (MALL_NO)

Substituting this variable for the distance to the nearest high order mall allows measurement of the effect of proximity to high order mall due to the presence of high order mall in the primary trade area. The main idea of incorporating this variable to generate an alternative model is to supplement the proximity effect of high order mall identified in the base model. As previously mentioned in the hypothesis deduction, it is expected that shopping center rent increases with the number of high order mall in the trade area. A significant positive sign on this variable would therefore further confirm the hypothesis.

4.4.3 Expected signs of variables

The details of each independent variable have been explained in the previous section. Their expected signs and corresponding reasons are summarized in Table 4.3

Table 4.3 Expected signs of independent variables

Independent variables	Expected results	Reasons
Physical attributes		
Age (AGE)	-ve	New and modern centers are expected to attract more customers, while older shopping centers may suffer from deterioration of facilities, and inappropriate tenant mix.
Natural log of Total Internal Floor Area (LN_IFA)	+ve	Larger centers have a higher degree of customer drawing power due to their diversity. They also possess more market power and thus greater ability to extract consumer surplus
Occupancy rate (OCR)	+ve	Occupancy rate is a proxy to show whether the shopping center is competitive enough

		for the retailers to survive. High occupancy rates are usually associated with the shopping centers that are capable to extract high rental rent from the tenants.
Market Position attributes		
District center (DC)	+ve compared with LC	District center has larger catchment population and provides a wider range of goods
Estate center (EC)	-ve compared with LC	Estate center mainly serves for local residential population and has limited variety of shops
Location attributes		
Distance to the nearest railway station (RAILWAY_D)	-ve	An inverse relationship is a direct result of accessibility. Shopping center in closer proximity to railway stations is more convenient, and hence can attract more customers
Hong Kong Island (HKI)		The expected results are preliminarily based on the demographic characteristics of locations. The most important characteristic is the population, as it reflects the most basic source of demand for retailers' products in shopping center. Shopping center in a location with larger population is expected to get a higher rent.
Kowloon East (KLE)		
Kowloon West (KLW)		
Kwai Chung (KC)		
Shatin and Ma On Shan (ST)		
Tsueng Kwan O (TKO)		
Tuen Mun (TM)		
Tai Po (TPO)		
Tung Chung (TC)		
Yuen Long (YL)		
Proxies for Hypothesis		
a) Distance to the nearest high order mall (MALL_D)	-ve	Shopping center in close proximity to high order mall can enjoy the positive demand externalities generated by the mall. The center is hence benefited from the additional pedestrian traffic. Proximity to high order mall also brings along multipurpose shopping benefits to the shopping center, which can reduce the customers' travel costs, and the search cost for products.
b) Number of high order mall in the primary trade area (MALL_NO)	+ve	

All of the expected signs are stated with corresponding reasons, except the ten location dummies. Empirical test has to be carried out in order to identify the actual location preference of the customers. However, a preliminary expectation of the effect of location dummies can be done through investigating the demographic characteristic of each location.

Location is universally accepted as a key factor affecting the rent of shopping center. In fact, there are many sub-factors constituting the factor of location, for example, demographic characteristics, accessibility, competition etc. The effects of accessibility and competition on shopping center rent have been taken into account in the models through their respective proxies. As the majority of customers of the shopping centers held under the Link are residents of the adjacent housing estates, it is reasonable to expect the effect of location dummies is mainly based on the demographic characteristic of each location.

The most basic source of demand for a retailer's product is the surrounding resident population. A large enough population is needed to support a particular type of shopping center. The population in a location determines the number of potential customers of shopping centers. It is particularly important for shopping centers held under the Link, as most of their customers are mainly residents from nearby housing estates. The populations of the ten location dummies are summarized in Table 4.4.

Table 4.4 Population of the ten location dummies 2006

District	Population
Hong Kong Island (HKI)[12]	587,097
Kowloon Central (KLC)	786,022
Kowloon East (KLE)	587,423
Kowloon West (KLW)	646,088
Kwai Chung (KC)	812,028
Shatin and Ma On Shan (ST)	607,544
Tsueng Kwan O (TKO)	373,000
Tuen Mun (TM)	502,035
Tai Po (TPO)	574,272
Tung Chung (TC)	79,000
Yuen Long (YL)	534,192

Sources: 1) 2006 Population By-census, the Census and Statistics Department, HKSAR government 2) Website of District Council

It is preliminarily expected that shopping center in a location with greater population can generate higher rent from the tenants, as the demand for retailers' product in the location is greater.

Apart from population, there are also other demographic factors that may affect the shopping center rent, for example household income, potential for population growth etc. However, the author does not incorporate them in the results expectation. The reasons are twofold. Firstly, it is difficult to determine the potential of population growth in a location. Secondly, the majority of customers of the shopping centers held under the Link are the residents from public housing. Hence, the information of household income in a location may not reflect its actual impact on the targeted shopping center, as the information includes all the residents, living in public housing and private housing, in the location.

[12] As all the shopping center observations on Hong Kong Island are located in the Eastern District, the population of Eastern District is hence used to give a more accurate account of its effect on shopping center rent.

Chapter 5: Empirical model and result

This chapter presents the empirical models and interprets the results. Section 5.1 describes the empirical models used in the study. Section 5.2 gives the summary of the group descriptive statistics of the variables in the model. Section 5.3 includes discussion on each independent variable.

5.1 Empirical model

Empirical test of the hypothesis (proximity of a shopping center to high order mall brings a positive effect on the rental income of the shopping center) can be done by a regression analysis on the base rent per square meter per month of the shopping center against a number of independent variables:

ln (RENT)= f (P, M, L, H)

where

ln (RENT) = The natural logarithm of the base rent per square meter per month of the shopping center held under the Link

P = a set of physical attributes, including

a) the age of the shopping center

b) the natural logarithm of internal floor area of the shopping center

c) the occupancy rate of the shopping center

M= a set of market position attributes, including

a) District center

b) Estate center

where Local center is the omitted variable

L = a set of location attributes, including

a) the distance to the nearest railway station

b) ten dummy variables distinguishing eleven different districts in Hong Kong specifying the locations of the shopping center, where Kowloon Central is the omitted variable

Proxies for Hypothesis = a) distance to the nearest high order mall

b) number of high order mall in the primary trade area

Hence, the empirical models are constructed as:

Base Model

$$\ln (RENT) = a_0 + a_1 AGE + a_2 LN\_IFA + a_3 OCR + a_4 DC + a_5 EC + a_6 RAILWAY\_D + a_7 HKI + a_8 KLW + a_9 KLE + a_{10} KC + a_{11} ST + a_{12} TKO + a_{13} TM + a_{14} TPO + a_{15} YL + a_{16} TC + a_{17} MALL\_D + \varepsilon$$

Alternative Model

$$\ln (RENT) = a_0 + a_1 AGE + a_2 LN\_IFA + a_3 OCR + a_4 DC + a_5 EC + a_6 RAILWAY\_D + a_7 HKI + a_8 KLW + a_9 KLE + a_{10} KC + a_{11} ST + a_{12} TKO + a_{13} TM + a_{14} TPO + a_{15} YL + a_{16} TC + a_{17} MALL\_NO + \varepsilon$$

where ε is the error term;

and a_i are the coefficients of the intercept and the corresponding independent variables.

After processing the data by computer statistical software, Eview 3.0, regression results are generated.

5.2 Result analysis

The data includes 113 shopping centers observations, and the data are summarized in the Table 5.1.

Table 5.1 Descriptive Statistics of Variables

Continuous variables	Mean	Standard Deviation	Max	Min
RENT	245.37	86.31	581.40	53.80
LN_RENT	5.44	0.36	6.37	3.99
AGE	15.92	7.69	31	4
IFA	8030.90	5122.31	37161.10	1567.60
LN_IFA	8.82	0.603	10.52	7.36
OCR	91.09	9.41	100	51
RAILWAY_D	0.745	0.477	2.25	0.03
MALL_D	1.43	1.29	8	0.16
MALL_NO	0.531	0.642	2	0
No of Observations = 113				

Dummy variables	No of Records
Market position dummies	
DC	36
LC	30
EC	51
Location dummies	
HKI	7
KLW	6
KLC	14

KLE	15
KC	13
ST	18
TKO	7
TM	11
TPO	13
TC	2
YL	7

The average monthly rent per square meter for the sample is $245.37 with a range of $53.8 to $581.4. Shopping center age ranges from 4 to 31 years, with a mean of 15.92 years. The mean IFA of the shopping center is 8,039.9 m^2. The smallest shopping center in the sample is 1,567.6 m^2 and the largest shopping center is 37,161.1 m^2. The average shopping center occupancy rate is 91.09% with a range of 51% to 100%. The nearest distance to railway station averages 0.745 kilometer, with a range of 0.03 to 2.25 kilometers. The nearest distance to high order mall ranges from 0.16 to 8 kilometers, with a mean of 1.43 kilometer. The average number of high order mall in the primary trade area is 0.531, ranging from 0 to 2.

To address possible heteroskedasticity in the models, White's (1980) test for heteroskedasticity is performed. Correlation matrixes are also generated to test the problem of multicollinearity. (Appendix 1 and 2) Based on the matrixes, it is found that the models does not present multicollinearity problem, as no pair of independent variables exhibiting correlation higher than the absolute value of 0.70.

5.3 Interpretation of results

Base model

Regression results from the base model are shown in the Table 5.1. The signs and magnitudes of the coefficients are generally as expected. The model shows an adjusted R^2 of around 50%. This means that 50% of the variation in the dependent variable can be explained by the variation in the independent variables. The empirical model shows a good explanatory power, as far as the generally low explanatory power of empirical retail study is concerned.

Table 5.2 Regression Results of the Base Model

Dependent Variable: LN_RENT			
Method: Ordinary Least Squares			
Included Observations: 113			
In White Heteroskedasticity-Consistent Standard Errors & Covariance			
Variable	**Coefficient**	**t-Statistic**	**P-Value**
Constant	8.700261	9.240220	0.0000
Physical Attributes			
AGE*	-0.022744	-5.539991	0.0000
LN_IFA**	-0.217815	-2.459622	0.0157
OCR*	-0.008982	-3.269440	0.0015
Market Position Attributes			
DC*	0.290947	3.337004	0.0012
EC*	-0.321130	-3.733651	0.0003
Location Attributes			
RAILWAY_D***	-0.107274	-1.768200	0.0802
HKI**	-0.357511	-2.3116311	0.0230
KLE	0.017714	0.144858	0.8851
KLW*	-0.295929	-3.666848	0.0004
KC	-0.075531	-0.838566	0.4038
ST	0.008349	0.107526	0.9146

TKO	0.029395	0.261370	0.7944
TM	0.082932	0.922493	0.3586
TPO	0.083681	0.984044	0.3276
TC**	-0.454382	-2.332829	0.0218
YL	0.084901	0.816852	0.4161
Proxy for Hypothesis			
MALL_D**	-0.039452	-2.418927	0.0175
Adjusted R^2	**0.496404**		
F-Statistic	**7.494160**		
Prob(F-Statistic)	**0.000000**		

* Significant at the 1% level

** Significant at the 5% level

*** Significant at the 10% level

Physical attributes

The physical attributes, AGE, LN_IFA and OCR are all found to be highly significant. This shows that the rental rent of shopping center is significantly impacted by its physical attributes. The interpretations of the variables are given below.

AGE

The age of the shopping center is shown to be inversely related with the rent, and is statistically significant at the 1% level. The result shows that the rent reduces by around 2% per one year older of the shopping center, ceteris paribus. It is the most significant variable in the physical attributes, showing its importance in determining the rental rate of shopping centers. The effect of age on the shopping center rent is as expected. Normally, the older the shopping center, the lower the shopping center rent, due to mainly the functional and physical deterioration and depreciation of the shopping center over time.

However, the negative effect of age on shopping center rent is not a must. There is empirical study, showing that the age and shopping center rent are positively related. (Tay, Lau and Leung, 1999) The main argument is that the centers are regularly renovated to update the facilities. Nevertheless, as most of the targeted shopping centers, especially the lower-tiered centers, in the study are not subjected to any renovation or refurbishment works at this moment, it is not unreasonable to reveal that the age has a negative impact on the shopping center rent.

LN_IFA

In contrast to the previous findings, the negative coefficient in IFA variable reveals that size has a negative impact on the rental rate of the shopping center. The author tries to explain this result using the Law of Diminishing of Marginal Returns. According to this relationship, in a production system with fixed and variable inputs (say factory size and labor), beyond some point, each additional unit of variable input yields less and less additional output. Generally, with reference to previous findings, a larger shopping center can generate higher rent from the tenants, due to larger customer drawing power. However, it is proposed that when the size of the shopping center exceeds its optimal point, continuous increase in size will conversely bring a negative impact on the shopping center rent. The optimum size in the shopping center, as well as the actual impact of size on the shopping center rent, inevitably requires further analysis before a more concrete conclusion can be drawn.

OCR

The occupancy rate is shown to be inversely related with the rental rate of shopping

center. The result is also in contrast with the previous findings. The direct reason leading to the result is not yet clearly identified. However, the author tries to explain the result in an alternative way. When the occupancy rate is low in a shopping center, it can somehow reflect the tenants' opinion that the shopping center rent is too high for them to survive, and vice versa. Also, as the occupancy rate is low, it implies there are more vacant premises in the shopping center. Thus, the bargaining power of the landlord is lowered and the rental rate is reduced consequently. The explanations can justify the unexpected result in a certain extent. Nevertheless, they are subjected to some limitations. For example, the explanations are probably applicable only in shopping centers, where the demand for retail spaces is small. It is because if the demand for retail spaces is high, the vacant spaces in the shopping center are chased by many retailers, the bargaining power of landlords is hence not lowered. It then makes the abovementioned explanations inapplicable. More detailed account of the observation requires further investigation.

Market Position attributes

Results for the market position attributes are as expected. Both the District center and Estate center variables are signed as expected and highly significant. Comparing with Local center, District center attract around 30% higher in rents, while on the other hand, Estate centers get around 30% lower in rents. The differences in rental level of different types of shopping centers are the result of their differences in factors, like size, catchment population, ranger of retailers etc.

Location attributes

With respect to the location attributes, RAILWAY_D is found to be a significant variable,

affecting the rental rate of shopping center. However, only three of the location dummies are found to be significant. The empirical results of the variables are discussed below.

RAILWAY_D

A decrease in distance to the nearest railway station from a shopping center has a positive impact on the rental rate of center. The result shows that shopping centers with 1 kilometer nearer to the nearest railway station can generate a 10 % increase in the rent from the tenants, ceteris paribus.

As previously mentioned, this variable is used as a proxy for the accessibility of the shopping center. Shopping centers in closer proximity to railway stations are considered to be more convenient and easily accessible to the customers. Thus, a higher rent can be generated from the tenants, as the shopping centers can attract more customers.

Location Dummy variables

Among the ten location dummy variables, only HKI, KLW and TC are found to be significantly affecting the shopping center rent. It is revealed that the shopping centers located on Hong Kong Island, Kowloon West and Tung Chung get a lower rent than that in Kowloon Central.

A major determinant of a successful shopping center is location. Apart from the accessibility of the location, demographic characteristics are also important to determinant the shopping center rent. The most basic source of demand for a retailer's product is the surrounding resident population. A large enough population is needed to

support a particular type of shopping center. The demographic information of the significant location dummies can be seen in Table 5.3.

Table 5.3 Population in four districts

District	Population
Hong Kong Island (HKI)	587,097
Kowloon Central (KLC)	786,022
Kowloon West (KLW)	646,088
Tung Chung (TC)	79,000

Sources: 1) 2006 Population By-census, the Census and Statistics Department, HKSAR government 2) Website of District Council

From the information, it can be observed that Kowloon Central has the largest population, while Tung Chung gets the least. As a result, it is reasonable to expect that, holding other variables constant, the rents of Kowloon West, Eastern District and Tung Chung are lower when compared to Kowloon Central. However, the results of other location dummies, though not significant, are mostly contrast to the prior expectation. It is keen that the explanation of the effect of location dummies based on population solely is not enough, the other demographic characteristics of location may also matter.

On the other hand, it is found that most of the location dummies in the model are not significant. There are several reasons to explain. Obviously, the main reason is the small sample size used in the study. Also, it is the result of uneven distribution of observations. The observations in the sample are not evenly distributed in different districts. Thus, the location effect in a particularly district can not be fully reflected in the empirical results. In conclusion, the abovementioned analysis is rather preliminary, the actual impact of population to the shopping center rent requires further investigation.

Proxies for Hypothesis

MALL_D

Being the focus of investigation in the study, the nearest distance to high order mall variable is appropriately signed and highly significant. Proximity to high order mall can benefit the shopping centers. The result reveals that shopping centers with 1 kilometer closer to a high order mall can get a 4 % increase in the shopping center rent. While proximity of shopping center to high order mall may incur competition, shopping center is also likely to benefit from the extension of the market range, as well as the spilling over of positive demand externalities from the high order mall. The result hence provides an evidence to support that the agglomeration gains can outweigh the competition loss. Thus, the hypothesized positive proximity effect of high order mall on shopping center rent can be confirmed.

Alternative model

As the base model shows positive effect for the rent of shopping center in closer proximity to high order mall, alternative model is generated to further confirm the effect of proximity to high order mall. Variable measuring the number of high order mall in primary trade area is added to the base model in place of the nearest distance to high order mall variable. This variable measures the effect of proximity to high order mall due to the presence of high order mall in the primary trade area. Regression results from the alternative model are shown in Table 5.4. The results are generally as expected. The model shows an adjusted R^2 of 50%. This means that 50% of the variation in the dependent variable can be explained by the variation in the independent variables.

Table 5.4: Regression results of the alternative model

Dependent Variable: LN_RENT			
Method: Ordinary Least Squares			
Included Observations: 113			
In White Heteroskedasticity-Consistent Standard Errors & Covariance			
Variable	**Coefficient**	**t-Statistic**	**P-Value**
Constant	8.537526	9.913067	0.0000
Physical Attributes			
AGE*	-0.022357	-5.542536	0.0000
LN_IFA**	-0.208352	-2.550100	0.0124
OCR*	-0.009063	-3.342218	0.0012
Market Position Attributes			
DC*	0.278715	3.312439	0.0013
EC*	-0.325966	-3.947154	0.0002
Location Attributes			
RAILWAY_D	-0.084875	-1.367198	0.1748
HKI**	-0.351383	-2.279016	0.0249
KLE	-0.001637	-0.013563	0.9892
KLW*	-0.334735	-4.137236	0.0001
KC	-0.085700	-0.931436	0.3540
ST	-0.025497	-0.314544	0.7538
TKO	-0.006049	-0.055950	0.9555
TM	0.050156	0.584625	0.5602
TPO	-0.021063	-0.281307	0.7791
TC**	-0.446623	-2.239047	0.0275
YL	0.055565	0.527772	0.5989
Proxy for Hypothesis			
MALL_NO***	0.079253	1.683844	0.0955
Adjusted R^2	**0.500177**		
F-Statistic	**7.592899**		
Prob(F-Statistic)	**0.000000**		

* Significant at the 1% level

** Significant at the 5% level

*** Significant at the 10% level

The results are similar to those from the base model. In the alternative model, AGE variable is negatively signed and highly significant as before. LN_IFA and OCR variables are also revealed to be inversely related with the shopping center rent. The results of market position attributes also show a similar result with the base model, DC and EC variables remain significantly positive and negative respectively. With respect to location attributes, location dummy variables, HKI, KLW and KC are statistically significant and negative, whereas the other location dummies remain insignificant. Interestingly, the only variable in this model that differs from the base model is the distance to the nearest railway station variable. Though the negative sign is as expected, the variable is not statistically significant.

The MALL_NO variable is statistically significant and signed as expected. The result shows that an increase of one additional high order mall in the primary trade area can bring an 8% increase to the shopping center rent. The findings of the alternative model provide additional evidence to support the hypothesized positive proximity effect of high order mall on shopping center rent.

Taken together, the base and alternative models suggest that the rental rate of shopping centers is affected significantly by physical, market position and location attributes. Additional important location factor identified in this study is proximity to high order mall. Shopping center located close to high order mall can benefit from the spilling over of positive demand externalities, as well as the extension of maximum range of potential center customers. Relatively, the effects of location dummies are found to be less significant. Nevertheless, in view of the small sample size, it requires further studies to investigate the location effect on shopping center rent.

Chapter 6: Conclusion

6.1 Summary of findings

It has often been said that the three most important properties of a retail store are location, location, and location (Jones and Simmons 1990). In a highly urbanized city, like Hong Kong, land is scarce and population is dense. Thus, selecting the location that can optimize market share, and hence profitability, is inevitably an important process for the developer of shopping center.

Regardless of the importance of location to the success of shopping center, little research focuses on the influence of shopping centers' locations on their rent. Hence, this study tries to seal this gap by studying the proximity effect of high order mall on the rental rate of shopping center in Hong Kong. While proximity to high order mall may incur competition, it may also be beneficial. With the availability of data from the Global Offering of the Link, a real estate investment trust in Hong Kong, the proximity effect of high order mall on the quasi-public shopping center rent is empirically studied. An empirical model relating shopping center rent and direct distance to the nearest high order mall is generated by applying multiple regression analysis. The significantly negative sign in the distance to mall variable confirms the hypothesized positive effect of proximity to high order mall. An alternative model is generated to further confirm the hypothesis by measuring the effect of proximity to high order mall due to the presence of high order mall in the primary trade area. The results provide some evidence of positive effect on shopping center rent due to aggregation of high order mall.

6.2 Implications of the study

The results of the study reveal that the positioning of shopping centers may not solely depend on simple law of demand and supply. Other location factors, like competition, accessibility etc. also matter. Thus, planners or developers of shopping centers should choose location with care. Shopping center site selection is a very strategic decision, because the decision can be used to develop a sustainable competitive advantage. Location decision has become more important in recent years, as there are more shopping centers opening new locations. This makes the better locations harder to obtain.

The results of this study give insight to the planners or developers about the proximity impact of high order mall on the shopping center rent. It is hoped that the findings can contribute in helping them to make an appropriate location decision in the development of shopping center. Practically, the findings in the study also imply that the planners or developers should take the location factors, especially competition in the trade area, into account when valuating a shopping center

6.3 Limitations of the study

1) Due to a small sample size used in the study, it is not possible to include too many variables in the empirical model. The inclusion of more variables may increase the explanatory power of the empirical model. Nevertheless, this will also increase the complexity of the model. Therefore, the independent variables used in the model are chosen mainly based on previous literatures. The proximity impact of high order mall identified in the study hence may not truly reflect the situation in the real world, as the effects of some factors are not taken into account. For example, micro- rent determinants are included in the empirical model to act as control for the analysis.

However, the effect of macroeconomic environment factors on the shopping center rent is also worth to consider and study.

2) The generality of the positive proximity effect of high order mall on the shopping center is not well identified. The reasons are twofold. Firstly, the investigation in this study mainly targets for the shopping centers held under the Link. It can only reasonably conclude that the positive effect identified prevails in these shopping centers. Whether the effect applies to centers held by other private owners is unknown. Also, due to a small sample size, most of the location dummies in the model are found to be insignificant. However, it is reasonable to expect shopping centers located in different regions should have different rental level. The location effects are not fully controlled in the study, which may alter the empirical results.

3) The direct distance to the nearest high order mall is used as the proxy for the hypothesis in the study. However, actual walking distance should reflect the proximity effect of higher order mall more accurately. It is because whether the shopping centers can benefit from the extension of market range and spilling over of positive externalities depends more on the walking distance between the two retail facilities. This in turn determines whether the customers will patronize in the shopping center due to its close proximity to high order mall. Nevertheless, subject to limited resources in the study, direct distance is used, rather than actual walking distance.

6.4 Further research areas

Though the proximity effect of high order mall on the shopping center rent is confirmed to be beneficial in the study, there are still questions that require further investigation. For example, how far the positive proximity effect of high order mall on the shopping center

rent can last? Or whether the benefit of mall proximity can persist over distance? Also, it is a good idea to identify the proximity impact of high order mall on other performance indicators of shopping center, like pedestrian flow, retail sales etc, if data is available.

Bibliography

Alexander, A. A. and Muhlebach, R. F. (1992) *Shopping Center Management.* Chicago, Institute of Real Estate Management

Benjamin, J. D., Boyle, G.. W. and Sirmans, C. F. (1990) "Retail Leasing: The Determinants of Shopping Center Rents", *Journal of the American Real Estate and Urban Economics Association*, 18(3), 302-12

Berry, B.J. (1967) *The Geography of Market Centers and Retail Distribution*, Englewood Cliffs, NJ: Prentice-Hall

Brueckner, J. K. (1993) "Inter-Store Externalities and Space Allocation in Shopping Centers", *Journal of Real Estate Finance and Economics*, 7, 5-16

Bucklin, L. P. (1967) "The Concept of Mass in Intra-Urban Shopping", *Journal of Marketing*, 31, 37-42

Chamberlin, E. H. (1933) *The Theory of Monopolistic Competition: A Reorientation of the Theory of Value*, Cambridge, MA: Harvard University Press

Chung, W and Kalnins, A (2001) "Agglomeration Effects and Performance: A Test of the Texas Lodging Industry" *Strategic Management Journal*, 22: 969-988

Delisle, J. R. (2005) "Shopping Center Classifications: Challenges and Opportunities", *ICSC Working Paper Series*, International Council of Shopping Centers

De Palma, Ginsburgh, A. V., Papageorgiou, Y. Y. and Thisse, J. F. (1985) "The Principle of Minimum Differentiation Holds under Sufficient Heterogeneity", *Econometrica*, 53, 767-81

Eaton, B. C. and Lipsey, R. G. (1975) "The Principle of Minimum Differential Revisited: Some Developments in the Theory of Spatial Competition", *Review of Economic Studies*, 42, 27-49

Eaton, B. C. and Lipsey, R. G. (1979) "Comparison Shopping and the Clustering of Homogeneous Firms", *Journal of Regional Science*, 19, 421-35

Eaton, B. C. and Lipsey, R. G. (1982) “An Economic Theory of Central Places”, *Economic Journal*, 92, 56-72

Eppli, M. J. (1991) *Retail Leasing Behavior with Anchor Tenant Externalities*, Ph. D. dissertation, University of Wisconsin-Madison

Eppli, M. J. and Benjamin, J. D. (1994) “The Evolution of Shopping Center Research”, *The Journal of Real Estate and Research*, 9(1)

Gatzlaff, D. H., Sirmans, G.. S. and Diskin, B. A. (1994) “The Effect of Anchor Tenant Loss on Shopping Center Rents”, *Journal of Real Estate Research*, 9, 99-110

Gerbich, M. (1998) “An Empirical Analysis of the Retail Tenant Mix”, *Journal of Real Estate Research*, 15(3)

Golledge, R. S., Rushton, G. and Clark, W. A. (1966) “Some Spatial Characteristics of Iowa’s Dispersed Farm Population and Their Implications for the Grouping of Central Place Functions”, *Economic Geography*, 42, 261-72

Hanson, S. (1980) “Spatial Diversification and Multipurpose Travel: Implications for Choice Theory”, *Geographical Analysis*, 12, 245-57

Hardin III, W. G. and Carr, J. (2006) “Disaggregating Neighborhood and Community Center Property Types”, *Journal of Real Estate Research*, 28(2), 167-193

Hardin III, W. G. and Wolverton, M. L. (2000) “Micro-Market Determinants of Neighborhood Center Rental Rents”, *Journal of Real Estate Research*, 20(3), 299-322

Hardin III, W. G. and Wolverton, M. L. (2001) “Neighborhood Center Image and Rents”, Journal *of Real Estate Finance and Economics*, 23(1), 31-46

Hardin III, W. G. , Wolverton, M. L. and Carr, J. (2002) “An Empirical Analysis of Community Center Rents”, *Journal of Real Estate Research*, 23:1/2, 163-179

Hui, E. C. M., Yiu, C.Y. and Yau, Y. (2007) “Retail Properties in Hong Kong: a rental analysis”, *Journal of Property Investment and Finance, 25(2), 136-46*

Ingene, C. A. and Ghosh, A. (1990) "Consumer and Producer Behavior in a Multipurpose Shopping Environment", *Geographical Analysis*, 22, 70-93

Jones, K. and Simmons, J. (1990) *Location, Location, Location- Analyzing the Retailing Environment*. Nelson: Canada

Koch, J. V. (1976) *Microeconomic Theory and Application*. Boston., Little, Brown & Company Limited

Lerner, A. P. and Singer, H. W. (1937) "Some Notes on Duopoly and Spatial Competition", *Journal of Political Economy*, 45, 145-86

Levy., M. and Weitz, B. A. (2004) *Retailing Management, 5th Edition*. Boston, Mcgraw-Hill Irwin

Losh, A. (1938) "The Nature of Economic Regions", Southern Economic Journal, 5(1), 71-78

Mason, C. and Quigley, M. (1996) "Non-parametric Hedonic Housing Prices", Housing Studies, 11(3), 112-33

Miceli, T. J. and Sirmans, C. F. and Stake, D. (1998) "Optimal Competition and Allocation of Space in Shopping Centers", *Journal of Real Estate Research*, 16, 113-26

National Economic Development (1971) *The Future Pattern of Shopping*, Her Majesty's Stationary Office: London

Nevin, J. R. and Houston, M. J. (1980) "Image as a Component of Attraction to Intraurban Shopping Areas", *Journal of Retailing*, 56, 77-93

O'Kelly, M. E. (1981) "A Model of the Demand for Retail Facilities, Incorporating Multistop, Multipurpose Trips", *Geographical Analysis*, 13, 134-48

Ott, R. L., Longnecker, M. (2001) *An Introduction to Statistical Methods and Data Analysis, 5th Edition*. Pacific Grove, CA : Duxbury

Ownby, K. L., Davis, K. and Sundel, H. H. (1994) "The Effect of Location Variables on the Gross Rents of Neighborhood Shopping Centers", *Journal of Real Estate Research*, 9(1), 111-124

Peck, R., Olsen, C. and Devore, J. (2005) *Introduction to Statistics and Data Analysis*. Belmont, CA : Thomson Brooks/Cole

Planning Department (1998) Hong Kong Planning Standards and Guidelines: Chapter 6. Available from: http://www.pland.gov.hk/tech_doc/hkpsg/english/ch6/ch6_text.htm

Reiman, M. A., Hill, R. C. (2001) *Using EViews for Undergraduate Econometrics, 2nd Edition.* New York, Wiley

Rushton, G., Golledge, R. S. and Clark, W. A. (1967) "Formulation and Test of a Normative Model for Spatial Allocation of Grocery Expenditures by a Dispersed Population", *Annals of the Association of American Geographers*, 57, 389-400

Sin, Y. M and Kwok, W. Y. (2006) Press Releases of Survey on Hong Kong Shopping Malls Investigates whether Aspirations of Hong Kong Shoppers and PRC Tourists are Satisfied (online). Chinese University of Hong Kong, MSC Programme in Marketing. Available from: http://www.cuhk.edu.hk/cpr/pressrelease/060621e.htm

Sirmans, C. F. and Guidry, K. A. (1993) "The Determinants of Shopping Center Rents", *Journal of Real Estate Research*, 8(1), 107-15

Sirmans, G.. S., Gatzlaff, D. H. and Diskin, B. A. (1996) "Suffering the loss of an Anchor Tenant," *Megatrends in Retail Real Estate", Research Issues in Real Estate* Vol. 3, pp 261-276 J.D. Benjamin (ed.), Norwell, MA: Kluwer

Stanley, T. J. and Sewall, M.A. (1976) "Image Inputs to a Probabilistic Models: Predicting Retail Potential", *Journal of Marketing*, 40, 48-53

Tay, R. S., Lau, C. K. and Leung, M. S. (1999) "The Determination of Rent in Shopping Centers: Some Evidence from Hong Kong", *Journal of Real Estate Literature*, 7, 183-196

The Link (2005) *Global Offering – The Link Real Estate Investment Trust*, Hong Kong: The Link

Webber, M. J. (1972) *The Impact of Uncertainty Upon Location*, Cambridge, MA: MIT Press

Website of Census and Statistics Department, HKSAR Government. Available from: http://www.censtatd.gov.hk

Website of District Council, HKSAR Government. Available from: http://www.districtcouncils.gov.hk

Website of Hong Kong Retail Management Association. Available from: http://www.hkrma.org

Website of National Research Bureau Online http://www.claritas.com/claritas/Default.jsp

Website of Rating and Valuation Department, HKSAR Government. Available from: http://www.rvd.gov.hk

White, J. R. and Gray, K. D. (1996) *Shopping Centers and Other Retail Properties: Investment, Development, Financing, and Management*. New York, John Wiley & Sons, Inc.

Appendix 1: Glossary of terms

Agglomeration gains: The external benefits generated to shopping center in close proximity to high order mall, including the spilling over of positive demand externalities, as well as the extension of maximum range of potential center customers.

Anchor tenants: The major store(s) in a shopping center that attract(s) customers to the center. The anchor varies with the scales and types of centers, for example, departments stores usually anchor regional and metropolitan shopping centers and supermarkets are typical anchors in community centers

Base rent: means, in respect of a Lease, the standard rent payable under the Lease, exclusive of any additional turnover rent and other charges and reimbursements

Catchment area: Area(s) from which a shopping center draws its customers.

High order shopping mall: The shopping mall with a total IFA over 300000 sq fit (27000 sq meter), and have more than 10 different types of retailer existed in the center.

Internal Floor Area (IFA): means the internal area available for the exclusive use of the occupier(s) of a building but excluding all common or service areas used in common for the building as a whole.

Occupancy rate: The ratio of occupied shops to total number of shops in the shopping center, expressed a percentage

Primary trade area: The geographic area from which the store or shopping center derives 60-65 percent of its customers. In this study, it is defined as a one-kilometer radius encircling the shopping center site

Quasi-public shopping center: The major customers of the shopping center held under the Link are the residents from nearby public housing estates. Thus, though privatized, many shoppers still consider them as quasi-public shopping centers.

Shopping center: a planned group of connected retail stores, usually with an attached parking area, specially developed on a parcel of private property and managed by a single organization

The Link: The Link Real Estate Investment Trust ("The Link REIT"), the first REIT listed in Hong Kong, investing in retail and carpark facilities.

Trade area: The geographic area from which a shopping center will obtain most of its customers, usually subdivided into primary, secondary and tertiary trade area zones. The size of the trade area depends on the type of center, location of competition and other factors.

Sources:

1) “Location, Location, Location- Analyzing the Retailing Environment” by Jones, K. and Simmons, J. (1990)
2) Shopping Mall Studies, by the American Studies at Eastern Connecticut State University
3) Link (2005, pp282)

Appendix 2: Correlation matrix of variables used in the base model

	LN_RENT	AGE	LN_IFA	OCR	MALL_D	RAILWAY_D	DC	EC	HKI	KLE	KLW	KC	ST	TKO	TM
LN_RENT	1														
AGE	-0.507205	1													
LN_IFA	0.084102	0.141270	1												
OCR	-0.013676	-0.132388	0.083859	1											
MALL_D	-0.103396	0.008857	-0.069998	-0.059208	1										
RAILWAY_D	-0.184382	0.147608	0.061596	0.040927	0.079344	1									
DC	0.316629	-0.075522	0.659900	0.142693	-0.087041	-0.009712	1								
EC	-0.311681	0.037663	-0.645278	-0.220278	0.080212	0.056187	-0.402725	1							
HKI	-0.117017	-0.045275	-0.072799	-0.134795	0.003454	-0.125086	-0.013350	-0.071363	1						
KLE	0.060745	-0.036809	-0.044626	-0.082946	-0.051862	0.077504	-0.036440	0.060109	-0.100538	1					
KLW	-0.145516	-0.131559	-0.157888	-0.029989	-0.131872	-0.212199	-0.158625	0.215130	-0.060853	-0.092644	1				
KC	-0.032605	-0.032474	-0.064243	-0.149549	-0.075639	0.061415	-0.121558	0.034460	-0.092655	-0.141060	-0.085380	1			
ST	-0.012691	0.190876	-0.020166	0.092746	-0.092898	-0.085373	-0.030084	-0.097409	-0.111859	-0.170297	-0.103076	-0.156945	1		
TKO	0.166753	-0.141170	0.057832	0.086552	-0.177351	-0.149837	0.066046	-0.071363	-0.066038	-0.100538	-0.060853	-0.092655	-0.111859	1	
TM	-0.128026	0.132089	0.061858	0.073422	0.050511	0.377506	-0.090849	0.072990	-0.084390	-0.128478	-0.077764	-0.118404	-0.142946	-0.084390	1
TPO	-0.011415	0.065332	-0.054003	-0.042110	0.594641	0.002102	-0.121558	-0.028346	-0.092655	-0.141060	-0.085380	-0.130000	-0.156945	-0.092655	-0.118404
TC	-0.036884	-0.156389	0.139639	0.096881	-0.073363	-0.025541	0.200386	-0.080700	-0.034494	-0.052515	-0.031786	-0.048398	-0.058429	-0.034494	-0.044081
YL	0.210734	-0.184323	0.081024	0.160596	-0.070635	0.098838	0.224836	-0.071363	-0.066038	-0.100538	-0.060853	-0.092655	-0.111859	-0.066038	-0.084390

	TPO	TC	YL
LN_RENT			
AGE			
LN_IFA			
OCR			
MALL_D			
RAILWAY_D			
DC			
EC			
HKI			
KLE			
KLW			
KC			
ST			
TKO			
TM			
TPO	1		
TC	-0.048398	1	
YL	-0.092655	-0.034494	1

Appendix 3: Correlation matrix of variables used in the alternative model

	LN_RENT	AGE	LN_IFA	OCR	MALL_NO	RAILWAY_D	DC	EC	HKI	KLE	KLW	KC	ST	TKO	TM
LN_RENT	1														
AGE	-0.507205	1													
LN_IFA	0.084102	0.141270	1												
OCR	-0.013676	-0.132388	0.083859	1											
MALL_NO	0.216858	-0.083604	-0.059308	0.094284	1										
RAILWAY_D	-0.184382	0.147608	0.061596	0.040927	-0.280368	1									
DC	0.316629	-0.075522	0.659900	0.142693	0.012458	-0.009712	1								
EC	-0.311681	0.037663	-0.645278	-0.220278	-0.029141	0.056187	-0.402725	1							
HKI	-0.117017	-0.045275	-0.072799	-0.134795	-0.156081	-0.125086	-0.013350	-0.071363	1						
KLE	0.060745	-0.036809	-0.044626	-0.082946	-0.039372	0.077504	-0.036440	0.060109	-0.100538	1					
KLW	-0.145516	-0.131559	-0.157888	-0.029989	0.235572	-0.212199	-0.158625	0.215130	-0.060853	-0.092644	1				
KC	-0.032605	-0.032474	-0.064243	-0.149549	-0.082581	0.061415	-0.121558	0.034460	-0.092655	-0.141060	-0.085380	1			
ST	-0.012691	0.190876	-0.020166	0.092746	0.130276	-0.085373	-0.030084	-0.097409	-0.111859	-0.170297	-0.103076	-0.156945	1		
TKO	0.166753	-0.141170	0.057832	0.086552	0.246070	-0.149837	0.066046	-0.071363	-0.066038	-0.100538	-0.060853	-0.092655	-0.111859	1	
TM	-0.128026	0.132089	0.061858	0.073422	-0.132716	0.377506	-0.090849	0.072990	-0.084390	-0.128478	-0.077764	-0.118404	-0.142946	-0.084390	1
TPO	-0.011415	0.065332	-0.054003	-0.042110	-0.082581	0.002102	-0.121558	-0.028346	-0.092655	-0.141060	-0.085380	-0.130000	-0.156945	-0.092655	-0.118404
TC	-0.036884	-0.156389	0.139639	0.096881	-0.006506	-0.025541	0.200386	-0.080700	-0.034494	-0.052515	-0.031786	-0.048398	-0.058429	-0.034494	-0.044081
YL	0.210734	-0.184323	0.081024	0.160596	0.073719	0.098838	0.224836	-0.071363	-0.066038	-0.100538	-0.060853	-0.092655	-0.111859	-0.066038	-0.084390

	TPO	TC	YL
LN_RENT			
AGE			
LN_IFA			
OCR			
MALL_NO			
RAILWAY_D			
DC			
EC			
HKI			
KLE			
KLW			
KC			
ST			
TKO			
TM			
TPO	1		
TC	-0.048398	1	
YL	-0.092655	-0.034494	1

Appendix 4: Data sample

Name of the shopping center	IFA	RENT	AGE	OCR	MALL_NO	MALL_D	RAILWAY_D	Name of the nearest high order mall
District Center								
Butterfly	15290.1	259.4	23	95.1	0	2.25	2.25	Tuen Mun Town Plaza
Cheung Fat	13953	301.5	17	84.4	1	0.6	0.6	Maritime Square
Cheung Hong	11879.9	180.7	26	92.2	0	1.1	1.2	Maritime Square
Choi Wan I	14279.1	193.9	16	95.4	0	1.2	0.75	Amoy Center
Choi Yuen	12076	181.1	24	99.6	0	7.2	0.18	Tai Po Mega Mall
Chuk Yuen (South)	12900.7	280.2	22	95.4	0	1.1	0.39	Holleywood Plaza
Chung On	7051	273.6	10	100	2	0.6	0.6	Sunshine City
Fu Tung	8861	179.3	9	100	1	0.25	0.21	Citygate
Hau Tak II	15353.5	295	13	88.2	1	0.16	0.25	East Point City
Heng On	9928	244.4	19	97.9	1	1	0.25	Sunshine City
Ho Man Tin (Ho Man Tin Plaza)	9192	308.7	5	88.7	0	1.35	1.1	Grand Century Place
Kai Tin	16526	407.8	7	69.4	0	1.15	0.06	APM
Kwong yuen	6964	290.3	15	99.5	0	1.45	1.1	Sha Tin City One
Leung King	17414	231.8	16	98.6	0	2.25	1.5	Tuen Mun Town Plaza
Lok Fu	37161.1	240	21	96.7	1	0.8	0.03	Kowloon City Plaza
Lower Wong Tai Sin (Wong Tai Sin Center)	14410.4	264.5	23	97.1	1	0.9	0.04	Holleywood Plaza
Oi Man	15199.7	210.6	31	90	0	1.5	1	Grand Century Place
Oi Tung	7536	243.8	5	96.7	0	1.3	0.21	Cityplaza

Po Lam	8576.9	243.6	17	97.6	1	0.4	0.33	Metro City
Sau Mau Ping	14245.5	475.4	4	97.6	1	1	0.95	APM
Sha Kok	10247.5	220.5	26	98	1	0.8	0.2	New Town Plaza
Sheung Tak	11384	463.2	8	99.7	2	0.5	0.45	Park Central
Shun Lee	18307.3	142	28	82.4	0	1.4	1.5	Amoy Center
Siu Sai Wan	8599.3	326.2	17	91.1	0	1.75	1.3	Heng Fa Paradise Mall
Tai Wo	13683.1	269.6	17	88.8	1	1	0.06	Tai Po Mega Mall
Tak Tin	8362.8	274.6	15	99.6	0	1.45	0.5	APM
Tin Chak	12693.8	343	5	95.8	0	1.5	2.1	Kingswood Plaza
Tin Chung (Chung Fu Center)	21029.3	323.5	7	92.2	1	0.7	1.625	Kingswood Plaza
Tin Shing	7418	319.7	6	100	1	1	0.15	Kingswood Plaza
Tin Shui II	6192.5	367.5	13	99.7	1	0.65	1.15	Kingswood Plaza
Tin Yiu I	7244	416.6	14	97.6	1	0.75	0.22	Kingswood Plaza
Tsz Lok (Tsz Wan Shan Center)	19819	347.1	9	62.3	1	0.9	0.75	Holleywood Plaza
Upper Wong Tai Sin (Lung Cheung Mall)	11826.5	350.8	5	99	0	1.05	0.04	Holleywood Plaza
Wo Che	16702.8	220.1	29	75.9	0	1.05	1.2	New Town Plaza
Yat Tung	17860.3	244.2	5	95.7	0	1.2	1.1	Citygate
Estate Center								
Cheung Hang	5241	179.7	16	97.1	0	1.1	1.15	Maritime Square
Chun Shek	2982.2	250.2	22	87.8	1	0.85	0.3	New Town Plaza
Fortune	1794	239.7	6	84.6	1	0.8	0.18	Dragon Center
Fu Cheong	6148	206.6	4	78.4	1	0.75	0.15	Dragon Center
Hing Man	2643	110.4	24	72.6	0	1.25	0.7	Heng Fa Paradise Mall

Hing Tin	2758.4	228.6	18	75.9	0	1.375	0.85	APM
Ka Fuk	4152	305.7	11	51	0	6	0.33	Tai Po Mega Mall
Kam Ying	3102	171.1	15	98.8	2	0.65	0.8	Sunshine City
Kin Sang	3609	196.2	16	89.6	0	2	1.2	Tuen Mun Town Plaza
Kwai Hing	2356	283.9	15	91.7	0	1.3	0.4	Metroplaza
Kwong Tin	5086	231.3	13	86.1	0	2	0.7	APM
Lai Kok	7276	112.9	25	81.7	1	0.4	0.18	Dragon Center
Lei Cheng Uk	7294	111.7	21	98.5	1	1	0.72	Dragon Center
Lok Wah (South)	1567.6	484.6	24	69.3	2	0.6	0.66	Amoy Center
Ming Tak	3454	206.7	7	87	1	0.54	0.6	East Point City
Ping Tin	2032	212.1	9	100	0	1.5	0.45	APM
Po Tin	5190.9	213.2	6	99	0	2.25	1.25	Tuen Mun Town Plaza
Sam Shing	6625.3	87.1	26	90.7	0	1.45	1.8	Tuen Mun Town Plaza
Shek Lei I	3625	351	13	81.3	0	1.5	0.8	Metroplaza
Shun On	6251.1	53.8	28	95.4	0	1.3	1.55	Amoy Center
Siu Lun	2621	218.7	13	100	1	1	1.25	Tuen Mun Town Plaza
Sun Tin Wai	5110.6	188.3	25	68.4	0	1.2	1	New Town Plaza
Tin Ma	3411.2	112.6	20	98.2	0	1.625	0.85	Holleywood Plaza
Tin Ping	5482.6	177.1	17	90.3	0	6.8	0.8	Tai Po Mega Mall
Tin Tsz	3061	306	9	98.9	1	0.55	0.75	Kingswood Plaza
Tsing Yi	3832	147.4	20	89.7	1	0.6	0.75	Maritime Square
Tsz Ching	1679	261.7	10	100	0	1.2	1.3	Holleywood Plaza
Tung Tau II	3587.1	157.7	24	80.9	1	1	0.8	Kowloon City Plaza

Wah Sum	2207	228.1	11	100	0	4.8	1	Tai Po Mega Mall
Wan Tau Hom	2320.1	245.2	24	86.7	0	1.3	0.42	Kowloon City Plaza
Local Center								
Cheung Wah	6215	175.3	22	82.6	0	6	0.35	Tai Po Mega Mall
Choi Ming	8146.4	463.9	5	93.6	1	0.5	0.3	Park Central
Fu Heng	5175	264.8	16	100	1	0.75	1.375	Tai Po Mega Mall
Fu Shin	9022.5	247.9	20	90.1	1	0.5	1.3	Tai Po Mega Mall
Fu Tai	5825	304.3	5	91.9	0	2.5	0.5	Tuen Mun Town Plaza
Fung Tak	6725.5	295.3	16	87.6	1	0.5	0.35	Holleywood Plaza
Hin Keng	8854.6	233.2	19	98	0	2.5	1.4	New Town Plaza
Hing Tung	4143	228.1	11	68.1	1	0.7	0.35	Cityplaza
Hing Wah I	6646	197.9	6	96.9	0	1.875	0.24	Heng Fa Paradise Mall
Hiu Lai	3113	170.5	10	100	0	1.2	1.2	APM
Hoi Fu	3296.3	288.8	7	98.2	2	0.42	0.48	Olymian City 2
Kai Yip	7076.4	205.6	25	97.7	0	1.1	0.8	Telford Plaza
Kam Tai	4255	210.5	5	100	0	2	0.2	Sunshine City
King Lam	4732	278	15	97.4	2	0.54	0.35	Metro City
Kwai Fong	5397	263.8	11	88	1	0.4	0.33	Metroplaza
Kwai Shing East	6681.1	216.9	7	86.7	1	0.85	0.51	Metroplaza
Kwong Fuk	6574	239.9	23	89.9	1	0.75	0.65	Tai Po Mega Mall
Lee On	4075	336.6	13	96.3	2	0.85	0.35	Ma On Shan Center
Lek Yuen	10642.2	162.9	30	97.8	1	0.6	0.7	New Town Plaza
Lok Wah (North)	10052	154.1	21	95	2	0.8	0.75	Telford Plaza

Long Ping	8717.1	164.4	19	94.4	0	2.375	0.5	Kingswood Plaza
Lung Hang	6437	276.5	23	97.7	0	1.625	0.6	New Town Plaza
Mei Lam	7519	214.7	25	86.7	0	1.5	0.75	New Town Plaza
On Ting	9442.6	194.1	26	94	1	0.8	1.1	Tuen Mun Town Plaza
On Yam	3792	292	12	64.7	0	2	1.55	Metroplaza
Po Tat	6816.3	424.3	4	85.7	0	1.3	1.1	APM
Shan King	10814.6	208.6	23	86.1	0	1.3	0.85	Tuen Mun Town Plaza
Shek Lei II	7336.1	227.7	7	89.5	0	1.5	0.8	Metroplaza
Shek Wai Kok	10642.6	115.5	26	90.7	0	1.5	0.8	Tsuen Wan Plaza
Shek Yam	6676	245.4	6	93.8	0	1.875	1.5	Metroplaza
Shun Tin	5164.6	203.3	25	89.5	1	1	1.3	Amoy Center
Sui Wo	5697.6	168.6	26	79.6	0	1.4	0.7	New Town Plaza
Sun Chui	6271.6	249.5	23	93.7	0	1.5	0.6	New Town Plaza
Tai Hing	9988	158.8	29	89.5	0	1.3	1	Tuen Mun Town Plaza
Tai Wo Hau	7240.6	224.3	22	83.8	0	1.4	0.35	Tsuen Wan Plaza
Tai Yuen	10468.8	178.9	26	85.3	1	0.45	1	Tai Po Mega Mall
Tsui Lam	8127	200.5	17	96.2	0	1.14	1	Metro City
Tsui Ping (North)	9501.7	223.3	16	94.2	1	0.7	0.75	APM
Un Chau	4391	224.3	7	98	1	0.9	0.21	Dragon Center
Wah Ming	4966	247.4	16	99.8	0	4.9	1	Tai Po Mega Mall
Wan Tau Tong	4404.3	291.8	15	94.8	0	1.35	0.48	Tai Po mega Mall
Wan Tsui	7462.2	201.6	27	93.6	0	1.5	0.15	Heng Fa Paradise Mall
Yau Mei and Ko Cheung (Lei Yue Mun Plaza) (Yau Tong)	9088	581.4	6	96.4	0	2	0.27	APM

Yau Oi	8750.6	228.3	26	90.5	1	0.8	1	Tuen Mun Town Plaza
Yiu On	4913.7	262.5	17	100	2	0.5	0.72	Sunshine City
Yiu Tung	5445	139.8	12	84.2	0	1.75	0.65	Heng Fa Paradise Mall
Yu Chui	9053	215	5	99.4	1	0.7	0.27	Sha Tin City One
Yung Shing	5050	212.7	7	97.7	0	4.9	1.2	Tai Po Mega Mall